

Handbook of the Flora and Fauna of South Australia, issued by the South Australian Branch of the British Science Guild (now incorporated with the British Association for the Advancement of Science), and published by favour of the Honourable the Premier (Hon. T. Playford, M.P.)

The Seaweeds

OF

South Australia

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ROYAL BOTANIC GARDENS,
STH. YARRA, S.E.1, VIC.

Part II.

The Red Seaweeds

BY

The late A. H. S. Lucas, M.A., B.Sc., and Mrs. Florence Perrin

*(With Introduction and Appendices by H. B. S. Womersley, B.Sc.,
and J. R. Harris, B.Sc.)*

WITH ILLUSTRATIONS

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ROYAL BOTANIC GARDENS,
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EDITORIAL PREFACE.

Part II. of this handbook deals in the main with the *Rhodophyceae* or Red Algae. This class of sea-weeds is by far the largest so far as number of species is concerned but has remained one of the least known groups of plants in South Australia. This has been due in large measure to the fact that no comprehensive account of the Australian Algae has been published since Harvey's "Phycologia Australica" in 1858-1863. Lists of species of South Australian Algae have been published on one or two occasions but descriptions of species, keys and illustrations have not been brought together in one place but occur scattered throughout many and often obscure publications.

This handbook is the work of several collaborators. Mr. A. H. S. Lucas, who compiled Part I. of this series, undertook to prepare Part II. At the time of his death in June, 1936, the manuscript was in note form to the end of the Subfamily Laurencieae. Mrs. F. Perrin, of Tasmania, kindly consented to complete the text, and Mrs. Perrin is therefore responsible for the arrangement of the work of Mr. Lucas and for the descriptions from the Laurencieae to the end of the classification.

The system of classification used by Mr. Lucas and Mrs. Perrin in this handbook is that of De Toni "Sylloge algarum omnium hucusque cognitarum" (1889-1924). The basis of this classification is a morphological one and in some measure is an artificial one. Within recent years investigations of the life histories of the Brown and of the Red Algae have tended to place classification upon an entirely new basis, and it appeared desirable that serious students of the Algae should have knowledge of modern classification.

The Handbooks Committee therefore invited Mr. H. B. S. Womersley and Mr. J. R. Harris, under the guidance of Professor J. G. Wood, to prepare revised classifications of the Green, Brown, and Red Algae which occur in South Australia. Mr. Womersley has prepared the appendices on the Green and Red Algae. He has also added numerous descriptions of species and several keys not given by Mr. Lucas and Mrs. Perrin, and using the algae collections in the Herbarium of the University of Adelaide has given definite records of species in South Australian localities. He has also revised the genus *Polysiphonia* to include all species recorded in the Southern Australian region. Mr. Harris has written an Introduction, which gives a generalized account of the life history of the Red Algae and also the revised classification of the Brown Algae in the Appendix.

The illustrations are from photographs by Mrs. Perrin and by Messrs. Womersley and Harris and also after those in Harvey's "Phycologia Australica." Miss Gwen D. Walsh, of the South Australian Museum, also assisted in the preparation of both photographs and drawings.

The Handbooks Committee realises that this book forms but the basis for further work which it hopes will by its means be stimulated. Descriptions of species, and especially the range of form, are admittedly often inadequate—and further collections will inevitably enlarge the area of distribution of many species, but these deficiencies are unavoidable in the present state of our knowledge of the Marine Algae in this State.

INTRODUCTION.

The Algae belong to the plant group Thallophyta, the group which contains those organisms which possess vegetative bodies undifferentiated into root, stem, leaves, etc. They range in form from the simplest unicells, to the collection of unicells in colonies, thence to multicellular, filamentous organisms and types in which the filaments become compacted in a gelatinous matrix to form a thallus, through to the highest thalloid forms in which the organization becomes more or less parenchymatous. The group Thallophyta includes two very large sub-groups—the Algae and the Fungi. These are differentiated from one another by their mode of nutrition, the former possessing a photosynthetic apparatus and thus being able to synthesize organic carbon compounds from simpler inorganic sources, while the latter are saprophytes or parasites requiring organic compounds in a ready-made form.

The Algae are divided by F. E. Fritsch, in his "Structure and Reproduction of the Algae" (1935) into 11 classes. The four listed below are the most important in Australian waters, and although some of the others are undoubtedly present they are otherwise quite unknown. This applies particularly to the large group of the Diatoms or Bacillariophyceae.

CHLOROPHYCEAE (Green algae).—Chromatophores grass-green in colour, containing the same four pigments (two green, two yellow) as in higher plants. Reproductive cells motile, ranging from isogamy to oogamy. The class is more widely represented in fresh than in salt water.

PHAEOPHYCEAE (Brown algae).—Brown colour is due to the brown pigment fucoxanthin masking the chlorophyll in the plastids. Thalli various, ranging from simple to highly developed tissue systems, some of which may attain gigantic proportions. Gametes ciliated with the cilia inserted at the anterior end of the pyriform zooid, and unequal in length.

RHODOPHYCEAE (Red algae).—Colour is due to the rose-pink pigment phycoerythrin in the chromatophores. Sexual cells typically non-motile. Carbohydrate storage product is Floridean starch replacing true starch. Thalli very variable in form and organization.

CYANOPHYCEAE (Blue-green algae).—Cells simple, with rudimentary nuclei, no proper chromatophore. Characterized by the pigment phycocyanin, giving the cells a blue-green colour. No motile stages known. No sexual reproduction, division occurring vegetatively. They range from unicells to aggregate—filamentous forms. Abundant in fresh waters, and common in the sea, though little is known of the Australian forms.

The algal flora of any natural body of fresh-water is predominantly a mixture of Greens, Blue-greens or Yellow-greens; the Browns are not represented, while among the Reds, only a very few of the more primitive types are known from such localities. In Australia an example of such

a type of Red is *Batrachospermum*, a mass of branching gelatinous filaments bearing verticils of brownish to greenish branchlets. In salt-water, however, this state of affairs is reversed, and whilst in a cursory examination of a marine flora the coarser Browns are the most strikingly obvious, yet as far as the number of different species is concerned, the Reds predominate. Lucas estimates that the percentage proportions of the various classes in Australian waters are approximately: Greens 11 per cent, Browns 19 per cent, Reds 70 per cent; so that it may be seen that the Reds contain more than twice as many species as the Greens and Browns together.

Among the Reds there is great range and diversity of the form of the thallus, and whilst some adult thalli hardly cover a sixpence, some, *e.g.*, *Cathymenia*, have a spread of up to 4-5 square feet, but none reaches the immense proportions of some of the coarser brown kelps, *e.g.*, *Sarcophycus* (bull kelp of Tasmania). In structure the thallus is multicellular, dendroid or forming flat leaf-like expansions, the filaments of cells being united in a gelatinous matrix or closely compacted with an inter-cellular cementing substance so that in section the frond assumes a pseudo-parenchymatous appearance. Unfortunately there are so many variations in the organization of the thallus that a superficial examination of the form and appearance of the plant may give no clue whatsoever to its true taxonomic position; hence to establish a complete specific identification, in addition to its morphological features some embryological data are also required. The group suffers, too, from the fact that a large number of species are very ill-defined, and seem to merge into one another in a series of gradations, and also that a large number of the species enumerated by early workers in this field are very incomplete or leave much to be desired in their species description, so that positive identification of these plants is often well-nigh impossible.

Although the Algae are generally regarded as a primitive and fairly simple group, the cytology of the Reds is by no means simple, and many of the metabolic and respiratory processes of the cell are still practically unknown, but this is principally due to the fact that so little exact work has been done on them. The innermost cells of the thallus are nucleate, clear and colourless, sometimes apparently empty and sometimes containing storage products, *e.g.*, Floridean starch, while the outermost cells contain the pink chromatophores, and are the assimilators, deriving their food supplies directly from the surrounding water, and these apparently are the seat of synthesis of metabolic products required by the plant. In the chromatophores, in addition to phycoerythrin, the chlorophylls α and β , xanthophyll and carotene are present while in addition, in some species, there are small amounts of phycocyanin which chemically is closely related to phycoerythrin. As yet there is conflicting evidence regarding the precise role of phycoerythrin in the algae, and although it is possible that it plays some vital role in the life of the plant, just what this is exactly is not known. It has been suggested that it is the determining factor enabling the red alga to carry on its processes of photosynthesis under conditions

of poor light, but the evidence is by no means clear cut. Due to the presence of phycocyanin in some of the Reds, and of phycoerythrin in some of the Blue-greens, it has been suggested that the two groups arose side by side, possibly even from some common stock, but while the close relationships of the two groups are stoutly affirmed by some phycologists, others are equally dogmatic in denying them upon grounds of lack of other confirmatory evidence.

Among the higher Reds (Euflorideae) there is also a complicated system of protoplasmic connections between adjacent cells. This generally takes the form of a central pit on the transverse walls closed over by a thin membrane, on either side of which the protoplasm forms denser, gel-like plates with strands passing directly through minute perforations. In this way the protoplasm of the filament is really continuous rather than the individual cells forming separate identities, resulting in the formation of a symplast in which there is a direct interchange of dissolved solutes, although cell inclusions, nucleus, chromatophores, etc., are unable to pass the barrier. This state of affairs is reminiscent of the connections of the sieve tube elements of the phloem (bast) of higher plants. Growth of the thallus occurs as an increase in length of the individual filaments from apical growing points.

Marine algae are subject to more even environmental conditions than many groups of higher plants. The open ocean provides a remarkably constant set of physical conditions over the whole globe. The surface temperature is never lower than 1° C. nor higher than 28° C., while at greater depths the temperature shows even less variation. The alkalinity (pH) of sea-water is remarkably constant as is the salinity which in turn determines its osmotic pressure. Along the coast where rivers flow into the sea there is a constant dilution of the sea-water, and the salinity is not quite as high. Here also the heating and cooling of the land masses will give rise to slightly greater fluctuations in temperature, but even so the sea provides a remarkably constant environment for life. The Rhodophyceae are comparatively insensitive to temperature variations, being world wide in distribution and occurring in abundance in both tropical and polar seas, although it is in the latter that they reach their maximum development. On the other hand, the Chlorophyceae are more sensitive to temperature and predominate in tropical oceans, while they are conspicuous by their absence in the polar seas which are essentially Rhodophycean. The Rhodophyceae are essentially plants inhabiting gloomy regions where little light penetrates, and so predominate in the depths of the ocean or in marine caverns and rock holes, and do not form as a rule any marked littoral zone which is such a prominent feature of the Browns. Some Reds do, however, flourish even above the high-tide limit, *e.g.*, *Catanelia*, *Caloglossa* and *Bostrychia*, where they are only occasionally wetted by ocean spray. As yet little work has been done upon the marine ecology of the algae, but in a shaded rock pool or marine cavern there is quite a marked change from the common littoral flora to one predominantly of Reds more usually

associated with deeper waters, yet able to flourish in the gloom of such places where other plants cannot obtain sufficient light.

The Red Algae form a well-marked but comparatively isolated group which arose in the Archaeozoic era. Sexual reproduction shows an alternation of generations in which three kinds of mature individuals may be produced in a regular succession or life-cycle. The life-cycles of the Euflorideae are fairly uniform and follow one or other of the two types which can be illustrated by a discussion of such typical genera as *Nemalion* and *Polysiphonia*. In either case there occurs a fusion of non-motile gametes (sexual cells) with consequential nuclear fusion to form a diploid zygote in which formation the chromosome number is doubled to the normal number of the adult plant. The Reds have been compared to the higher seed plants (Phanerogams) in that in both cases the sperm cells are non-motile and without cilia and are hence passively carried to the receptive portions of the female organ which remains imbedded in the mother-plant. Fertilization affects not only the zygote formed by the fusion of the two sex cells, but also cells in the neighbourhood, *cf.* endosperm in Angiosperms and the so-called auxiliary cells of the Reds, both of these tissues playing a most important role in the nourishment of the developing sporophyte. In the Red Algae this takes the form of the so-called gonimoblast filaments from which carpospores are formed which germinate to give the mature sporophyte generation. *Nemalion* has a life-cycle typical of many of the simpler Euflorideae, while *Polysiphonia* is typical of the more advanced types with quite a complex life-cycle.

(a) *Nemalion* possesses a thallus consisting of a long, dichotomously-branched cylinder, made up of a dense mass of interwoven, branching filaments imbedded in a gelatinous matrix. In the central portions of the thallus the filaments predominantly run lengthwise, with numerous lateral branches arising from these at right angles to form the denser outer portions. The cells of these filaments are uninucleate, and in addition in the outer assimilatory cells there is a single star-shaped plastid in which lies a pyrenoid surrounded by starch granules. Within the filaments adjacent cells are in intercommunication through continuous strands of cytoplasm passing through pores of various sizes on the cross-walls.

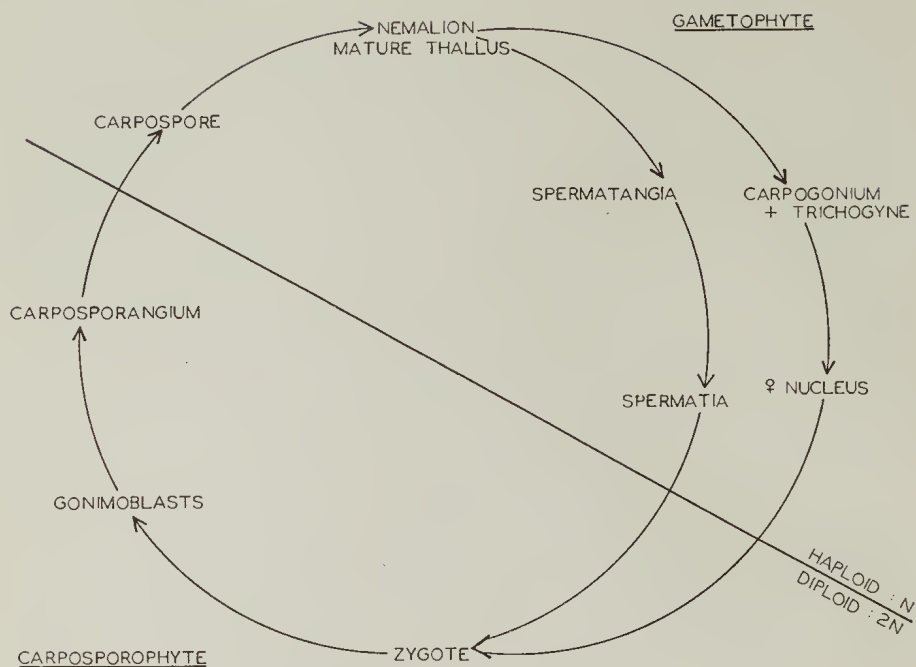
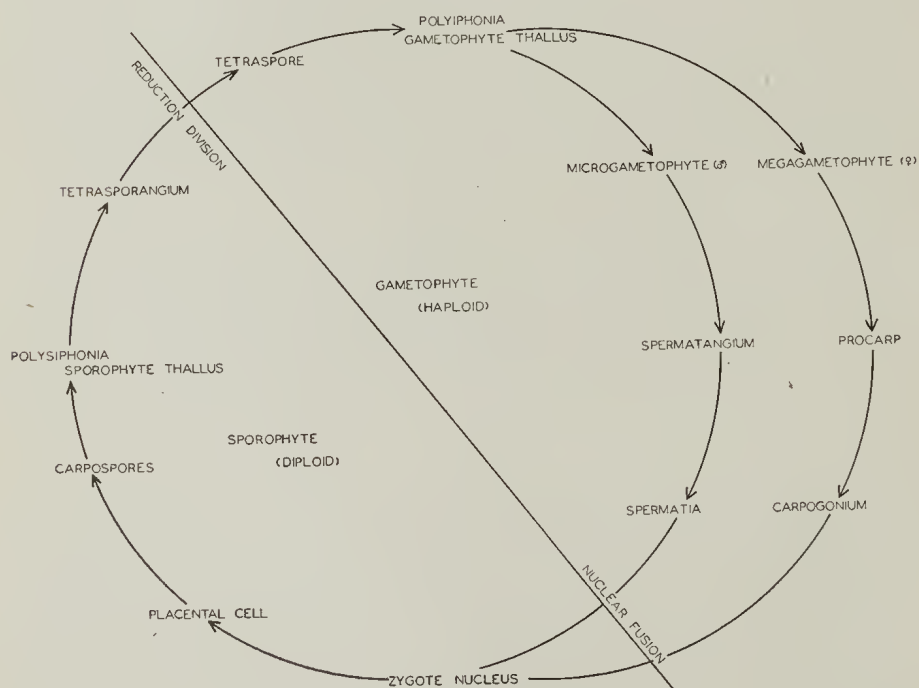
The male sex organ is the spermatangium, incorrectly termed by some authors an antheridium, borne terminally in dense clusters on a short lateral branch easily distinguished from vegetative branches due to the fact that it is completely colourless, or the chromatophore is only very poorly developed. The initial of such a branch arises as an apparently normal vegetative cell terminating a lateral filament from the central core, but then proceeds to cut off a chain of 4-7 cells, each of which becomes a spermatangial mother-cell which will give rise to four radially disposed spermatangia. Within this spermatangium the actual male sex cell is the spermatium, consisting of a single nucleus and rudimentary chromatophore, and upon its liberation by rupture of the spermatangial wall, a new spermatangium develops within the wall of the old one.

The female organ is the carpogonium arising from an initial cell near the base of a lateral filament from the central core, but it acts as an apical cell and proceeds to cut off a number of daughter cells, usually three. The apical one becomes the carpogonium, at first rounded, but soon producing a long, hair-like protuberance at the distal end, the trichogyne, and this becomes the receptive portion of the organ while the swollen base contains the female nucleus and is the egg proper. Sometimes the complete female reproductive organ is termed a procarp, in this case consisting of the carpogonium plus the supporting cells, but Kylin's definition of a procarp restricts the term to the carpogonium plus an auxiliary cell or auxiliary mother cells, and as these are not formed in *Nemalion* the term cannot be applied in its properly accepted sense here.

A non-motile, uninucleate spermatium is passively carried by water currents to the receptive trichogyne upon which it lodges, and the walls between the two break down at the point of contact allowing the male protoplast to pass into the trichogyne. There it divides almost immediately to produce two male nuclei which pass down the trichogyne, and one of them fuses with the single carpogonial nucleus to form a zygote. The zygote nucleus increases in size, then divides meiotically into two daughter nuclei, one of which, the lower, disintegrates; the other divides a number of times and the daughter nuclei so formed migrate to peripheral portions of the cell which later begins to form protuberances, from which short compactly-branched filaments, the gonimoblasts, arise. The terminal cells of these filaments become swollen to constitute a carposporangium, the wall of which ruptures at maturity to liberate carpospores, and this is often followed by a proliferation of a new carposporangium within the wall of the old one so that several successive carposporangia may be proliferated in the one season. On germination the carpospore gives rise to a normal *Nemalion* plant.

Thus we see that there is a distinct alternation of generations with a definite gametophyte generation represented by the normal plant, and a definite sporophyte generation, reduced to the gonimoblast filaments on which carpospores are produced. The haploid chromosome number is eight (*i.e.*, of the thallus and carpospores), and of the gonimoblasts and carpogonium 16, the diploid number. Diagrammatically the life-cycle can be represented as in Fig. 1.

(b) *Polysiphonia*.—A number of species are known from the Southern Australian region, varying in size from small epiphytes to forms 20 cm. or 30 cm. high. They are typically bushy, with dichotomous, alternate or irregular branching. The stem or branch consists of a central septate tube or siphon, usually small, surrounded by a row of larger cells, which are in many species very regularly arranged in transverse tiers. These pericentral cells vary from four to 24, but are usually constant for a species. In some of the larger species cortication may occur, and although the pericentral cells are still clearly visible in a transverse section, the articulate nature of

Fig. 1.—Life cycle of *Nematium*.Fig. 2.—Life cycle of *Polysiphonia*.

the branches is lost except in the youngest parts. Short, uniseriate, assimilatory filaments, dichotomously branching, may be formed from an initial cell a few cells from the apical cell, and these are called trichoblasts, being borne in spiral succession and are almost colourless. In some species an early abscission of the trichoblasts occurs, but in some they may be retained longer.

Polysiphonia is normally dioecious, the male and female reproductive organs being borne on separate plants, but occasionally cystocarpic plants may produce spermatangia. The spermatia are borne in a densely crowded mass upon short club-shaped branches upon a fertile trichoblast from which they are liberated in large numbers and passively carried by water currents to the trichogyne of the female organ, the procarp. The procarp develops from a central axial cell next to the apical cell of a short lateral ramulus, and this gives rise to a pericentral cell, the supporting cell, from which a four-celled carpogonial branch grows outwards and upwards in a curved manner so that the terminal cell of the series, which will become the carpogonium, is now situated above the pericentral cell from which it arose. The terminal carpogonium is at first rounded and uninucleate, but on mitosis two nuclei are produced, and the carpogonium begins to extend forth a process which is to become the trichogyne, and one of the nuclei migrates into it to become the trichogyne nucleus and the other remains as the female nucleus. Coincident with the extrusion of the trichogyne the supporting cell cuts off the two sterile filament initials, one basally and the other laterally. The lateral filament initial divides immediately, but the basal one remains undivided for a time.

At this stage fertilization takes place when a spermatium contacts the trichogyne, essentially in the same manner as for *Nemalion*, but in this case there is no division of the male nucleus in the trichogyne, and it is a single male nucleus which fuses with the carpogonial nucleus. The trichogyne nucleus is by now very ill-defined, and the trichogyne withers and dies. By now the lateral sterile filament has become four- to ten-celled and the basal sterile filament is two cells long. The supporting cell then buds off another daughter cell at the upper surface just below the carpogonium, and this is the all-important auxiliary cell, which soon establishes a tubular contact between the fertilized carpogonium and the supporting cell, so that a multinucleate fusion cell results containing the diploid zygote nucleus and a number of haploid gametophytic nuclei derived from the auxiliary and supporting cells. This cell becomes very large, and from the upper portion of the auxiliary cell the gonimoblast grows out as a densely compacted mass of filaments, each cell of which is uninucleate with a diploid nucleus, *i.e.*, the gonimoblast is sporophytic. Elongate carposporangia are borne terminally at the extremities of the gonimoblast filaments and each contains a single carpospore with a diploid nucleus. As the carposporophyte develops at first only the auxiliary cell is involved in producing the gonimoblast initials, but there is a gradual fusion of the supporting cells, the auxiliary

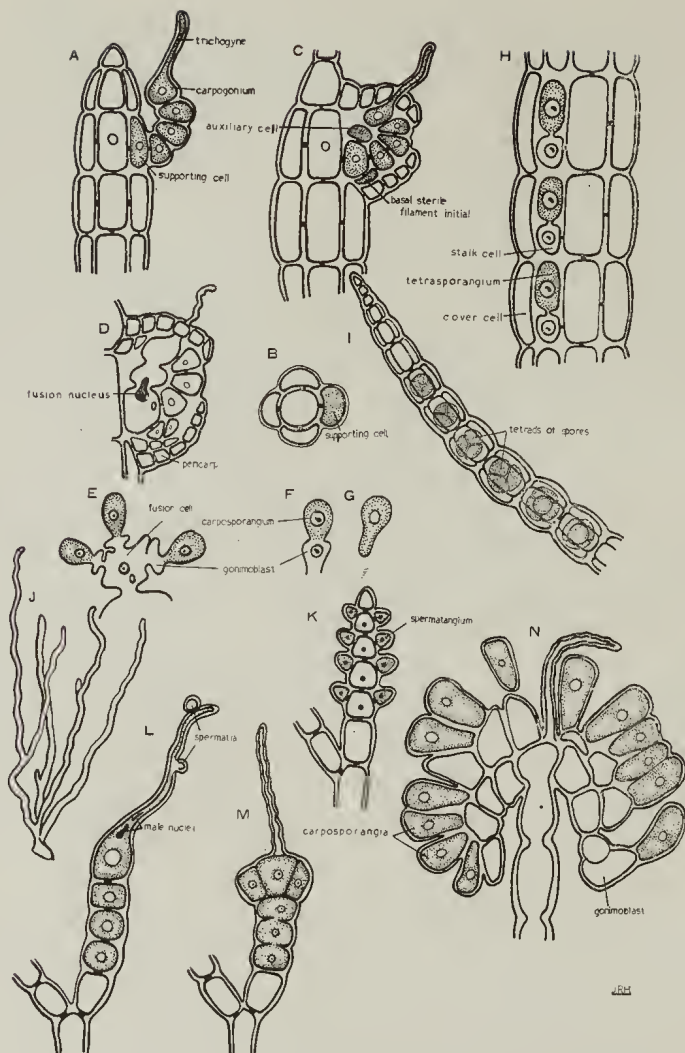


Fig. 3.—*Polysiphonia* (after Yamanouchi, Tilden, and Smith):

A, young carpogonial branch showing the supporting cell, carpogonial filament and carpogonium with trichogyne; B, the same in transverse section to show the pericentral supporting cell; C, carpogonial branch showing basal sterile filament initial and auxiliary cell, with developing pericarp enclosing organ; D, after fertilization showing the zygote nucleus migrating into the fusion cell; E, carpogonophyte with gonimoblast filaments bearing carposporangia; F, mature carposporangium; G, carpospore; H, formation of tetraspores in sporophyte filament; I, mature tetrasporic filament. *Nemalion* (after Cleland and Smith): J, *Nemalion* thallus; K, spermatangial branch; L, carpogonial branch at stage of fertilization showing spermatia, with male nuclei in the trichogyne; M, showing division of zygote after fertilization; N, carposporophyte showing gonimoblasts with terminal carposporangia.

cell and the cells of the sterile filaments into the one large, irregularly-shaped placental or central cell. The carpogonial filament withers and plays no part in the nutrition of the developing carposporophyte, which when mature is not freely exposed, but is closed over by a flask-shaped or urn-shaped envelope, the pericarp, with a conspicuous ostiole at its distal end. Actually the pericarp begins to develop even before fertilization from pericentral trichoblast cells adjacent to the supporting cell, and the whole fruiting structure of pericarp, supporting cell, auxiliary cell and gonimoblast filaments or carpogonial filaments and carpospores is called a cystocarp.

Carpospores are profusely liberated from the cystocarp *via* the ostiole of the pericarp and are carried passively by water currents. They soon fall to the sea floor and in a few hours begin to divide mitotically, the nucleus retaining the diploid number of 40 chromosomes, and eventually develop into mature thalli which bear neither spermatangia nor carpogonia. Cytologically this sporophyte thallus differs from the gametophyte thallus which bears sex organs (although they are not morphologically distinguishable) in that tetraspores are produced in unilocular tetrasporangia. The tetrasporangium is formed from a special pericentral cell cut off laterally from axial cells of a ramulus, and rows of tetrasporangia are produced on successive tiers. The fertile pericentral cell first cuts off a daughter cell on its outer face, and this in turn cuts off a pair of cover cells at the upper face, and in some species a smaller peripheral cell in addition. The fertile pericentral cell divides once transversely, and of the two daughter cells formed, the lower is the stalk cell and the upper becomes the tetrasporangium, and this increases in size to become quite large. The chromosome number of the single nucleus is diploid, and by reduction division four tetrahedrally disposed haploid tetraspores are formed. On rupture of the sporangial wall the mature tetraspore escapes. Its germination is very similar to that of a carpospore except that the nucleus contains only 20 chromosomes, the haploid number, and so gives rise to a gametophyte thallus which bears sex organs. Diagrammatically this life-cycle can be represented as in Fig. 2.

(c) *Modifications in Other Life-cycles.*—The typical reproductive cells of the Euflorideae are the non-motile gametes which fuse to form a fertilized egg (zygote) which never separates from the mother-plant but which remains in intimate contact with it and is nourished by it to produce the so-called gonimoblasts which in turn bear carpospores. On germination these give rise to new individuals. In *Nemalion* these are the normal gametophytic thalli which bear sex organs and so complete the life-cycle, but in *Polysiphonia* these individuals are sporophytes and undergo a reduction division to produce tetraspores from which the gametophytic thalli arise. Thus there are two types of alternation of generations and Svedelius calls the former type as in *Nemalion* where no tetraspores are formed, the haplobiontic type, and the latter type as in *Polysiphonia*, where there is a regular alternation between individuals bearing gonimoblasts and

individuals bearing tetraspores, the diplobiontic type. The haplobiontic Eufloridae all belong to the order Nemalionales with one exception, viz., one species of the genus *Liagora*, a member of this order in which the gonimoblasts produce carpospores and tetraspores.

To produce any phylogenetic classification of the Reds, Kylin and his school have shown that it is essential to take into account the nature and formation of the auxiliary cell and the method in which the developing gonimoblast derives nourishment from the mother-plant. Schmitz, as early as 1883, pointed out that sporogenous filaments of the Rhodophyceae connect themselves with nutritive cells in the mother-plant, and called these auxiliary cells, but later Kylin (1928) pointed out that these are really of two types, the first being purely nutritional in function and the others serving both as food suppliers and as the starting point of the gonimoblasts, and it is to this latter group that he restricts the term typical auxiliary cells. These are found in the orders (Kylin classification throughout) Cryptonemiales, Gigartinales, Rhodymeniales, and Ceramiales, but they are lacking in the orders Nemalionales and Gelidiales, where they are replaced by various cells of the purely nutritive types. Within the different orders various modifications of the typical life-cycles of *Nemalion* and *Polysiphonia* do occur, and briefly they can be listed as below:—

NEMALIONALES.—The gonimoblast derives all its food from the mother-plant *via* the carpogonial branch (see life-cycle of *Nemalion*) and is connected to the mother-plant only through this branch.

GELIDIALES.—Before fertilization many food-storing filaments are developed, and these loosely twine around the *central cells* of the procarys. The gonimoblasts grow (out) directly from the fertilized carpogonium and obtain their nutritive material from these food-containing filaments. The Gelidiales belong to the diplobiontic Eufloridae.

CRYPTONEMIALES, GIGARTINALES, RHODYMENIALES, CERAMIALES.—The gonimoblast never develops from the fertilized carpogonium, but the zygote connects itself in some way or other with a cell in the mother-plant and the gonimoblast develops from this, *i.e.*, the *typical auxiliary cell* of Kylin (see life-cycle of *Polysiphonia*) after the diploid nucleus has migrated into it. The carpogonial branch plays no part in food transference.

Kylin has shown that one of four types of *typical auxiliary cell* may be produced in the Rhodophyceae. These are:—

- (1) The *Dumontia* Type.—The auxiliary cells appear in special accessory branches which are developed prior to fertilization. This type is characteristic of the order Cryptonemiales. In the lower forms, *e.g.*, *Dumontia*, *Dudresnaya*, and *Grateloupia* long connecting filaments transfer the diploid nucleus from the carpogonium to a number of auxiliary cells remote from the carpogonium. In the higher forms, *e.g.*, *Kallymenia* and *Callophyllis* the carpogonium and auxiliary cells form a unit which is called

the *procarp*, generally with direct connection between carpogonium and the auxiliary cells.

- (2) The *Platoma* Type.—A normal intercalary cell of the mother-plant serves as an auxiliary cell. This type is characteristic of the order Gigartinales, in which the fertilized carpogonium becomes connected to the auxiliary cell in a manner identical with that in the order Cryptonemiales. Examples of the simpler types in this order are *Platoma*, *Furcellaria*, *Agardhiella*, and *Rhabdonia*, and of the higher types in which a procarp is formed *Cystoelonium*, *Calliblepharis*, *Hypnea*, *Phyllophora*, and *Gigartina*.
- (3) The *Rhodymenia* Type.—The auxiliary cell is already cut off from a daughter cell of the supporting cell prior to fertilization. This type is characteristic of the order Rhodymeniales, in which the carpogonium and auxiliary cell always form a unit, the procarp, with direct connection between the two.
- (4) The *Ceramium* Type.—The auxiliary cell is cut off from the supporting cell of the carpogonial branch after fertilization. This type is typical of the order Ceramiales, in which procarps are always formed, but in a few of the more primitive species connection may not be direct but through a short one-celled or sometimes two-celled connecting filament, *e.g.*, as in *Antithamnion*, *Callithamnion*, *Spermothamnion*, and *Dasya*. For the more advanced types forming the procarp, see the life-cycle of *Polysiphonia*.

THE CLASSIFICATION OF THE RED ALGAE.

From an examination of the life-cycle of *Polysiphonia* it may be seen that the one species produces three sorts of mature thalli in regular succession, and unless fruiting, these are morphologically indistinguishable. However, some algae are homothallic, *i.e.*, they bear both male and female organs on the same thallus, and in some species the generation bearing tetraspores is unknown. Kylin and his associates have attempted to classify the Red Algae upon a phylogenetic basis, and to do this they have shown that it is necessary to take into account the manner in which the gonimoblast develops and obtains its nutritional requirements. Such facts as these are not readily ascertained without exact cytological studies, often upon plants grown in artificial culture media, and these require the facilities of a well-equipped botanical laboratory, and while this may be available to the pure taxonomist, it is of little help for the field worker. As the majority of the early phycologists were essentially collectors, their early classifications reflect this viewpoint upon the group and were in the main essentially morphological classifications. However, as any botanist soon becomes aware, a classification based purely upon vegetative structures ceases to be a natural one, and is also very prone to error due to variations from plant to plant reflecting environmental conditions. Among the Red Algae there is such

a large number of species available along any local stretch of coastline, and which seem to exhibit a seemingly unlimited range of thallus forms, that it is not long before the morphologist is well out of his depth. It has already been emphasized that not too much reliance can be placed upon vegetative characters alone in making a species determination, a fact profoundly illustrated upon looking through the herbarium of some amateur collector. These seemingly almost identical thalli are found to be assigned to widely separated groups, often in quite different orders, while some species seem to be so sensitive to local environmental conditions that the range of forms exhibited by the species seems at first sight wide enough to accommodate several separate species. Size, texture of the frond and depth of colour can all be quite misleading and seem insufficient grounds for separating allied species. These pitfalls, of course, are not limited to the Reds alone, as numerous examples of such could be quoted at will from both the Greens and the Browns, but outstanding examples in the latter group are such genera as *Hormosira* and *Ectocarpus*, which are most difficult to subdivide into a number of species although their generic characters are quite well marked.

The text of this book follows the classification of De Toni in his *Sylloge Algarum Omnium Hucusque Cognitarum* (1889-1924), a classification essentially based upon morphological characteristics. It should be emphasized that such a classification is now obsolete and one which would not be retained except that the most natural classification, viz., that based upon the work of Prof. Harald Kylin of Lund, Sweden, is as yet rather incomplete, for although its orders and families are well established, there are still many genera among the Reds which have been incompletely investigated cytologically. Although their probable taxonomic position could be shrewdly guessed at, in the absence of reliable exact investigation they must remain unplaced. In the *Appendices* to this book there will be found an outline of the Kylin classification, and as many of the South Australian genera as we have been able to find placed are listed. Our information has been principally derived from the following works which use this classification:—

TILDEN, J. E. (1935).—*The Algae and Their Life Relations* (Minneapolis).

TAYLOR, W. R. (1937).—*Marine Algae of the North-Eastern Coast of North America* (University of Michigan).

SMITH, G. M. (1938).—*Cryptogamic Botany*, Vol. I. (McGraw-Hill).

KYLIN, H. (1937).—*Anatomie der Rhodophyceen* (Berlin).

Localities are given from which known specimens have been collected in South Australia, but in most cases the range could undoubtedly be extended by more widespread collecting. The term "Eastern Bays" includes Lapeche, Guichen, Rivoli, and MacDonnell Bays.

RHODOPHYCEAE (Red Seaweeds).**Subclass PROTOFLORIDEAE Rosenvinge.**

Morphological alternation of generations not present, the plants being either entirely non-sexual, or consisting of monoecious or dioecious gametophytes, the zygote representing the sporophyte: protoplasmic continuity between cells not evident. No true trichogyne.

Order BANGIALES Schmitz and Hauptfleisch.

The only Order with the characters of the Subclass.

Family BANGIACEAE Zanardini.

Thallus (Australian) erect, filiform or foliaceous, cells with intercalary growth, each containing a single axial stellate chromatophore, with a large central pyrenoid, without pores in the crosswalls.

Frond filiform *Bangia* Lyngbye.

Frond foliaceous *Porphyra*

C. Agardh.

BANGIA Lyngbye.

Frond gelatinous, filiform, attached at base, cylindrical or constricted, densely tufted, at first consisting of a single row of cells, later becoming several cells in thickness. Reproduction non-sexual by means of monosporangia (undivided tetrasporangia) and sexual by antheridia and oogonia.

Bangia fusco-purpurea (Dillw.) Lyngbye.

Growing gregariously in red patches on faces of rocks near high water mark. The threads are 2 cm. to 10 cm. long, 18 μ to 60 μ diameter. Red when growing, dark-purple on drying. Widely distributed in temperate waters of both hemispheres.

PORPHYRA C. Agardh.

Fronds erect, foliaceous, thin, flat, gelatinous, mostly monostromatic, attached by a disc formed by the cells near the base growing downwards in the way of rhizoids; entire or lobed or lacinate, often undulate at the margin. Colouring matter phycoerythrin, characteristic of the higher Rhodophyceae, and phycocyanin, characteristic of the blue-green Cyanophyceae. Sexual reproduction by means of motionless sperms and eggs which do not project a true trichogyne, the zygote dividing into 4 to 8 spores; non-sexual reproduction by monosporangia (undivided tetrasporangia). A genus abounding in cold climates and purely marine. It supplies more food for man than any other alga.

Porphyra umbilicalis (L.) J. Agardh.

The common species in Australia, occurring from Sydney round the southern coast to Fremantle, and in Tasmania and New Zealand, has been identified by E. S. Barton (Mrs. Gepp) of the British Museum of Natural History as being identical with the *P. umbilicalis* of the Atlantic and North

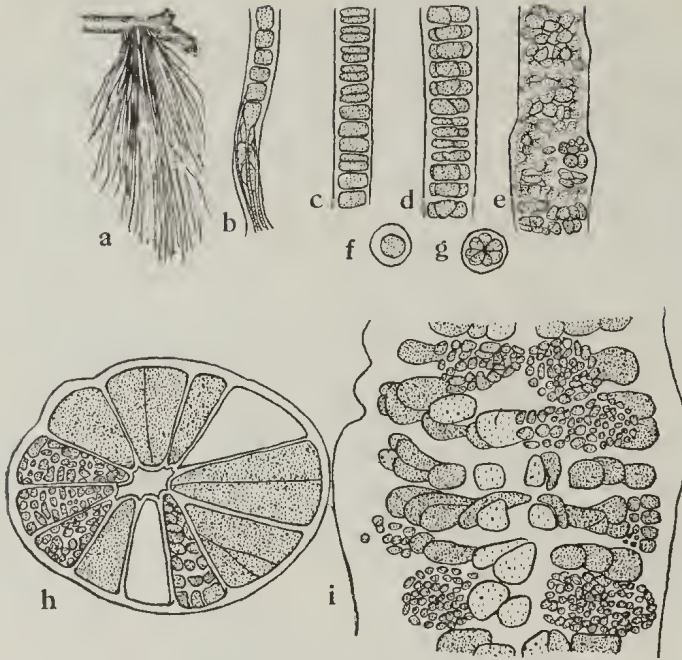


Fig. 4.—*Bangia fusco-purpurea*: *a*, plants attached to a twig; *b* to *e*, different portions of same filament; *f* and *g*, transverse sections of the plant; *h*, transverse section of plant showing sperms; *i*, surface view of plant showing sperms. (After Tilden.)



Fig. 5.—*Porphyra umbilicalis*.

Pacific. Here it is found at all seasons of the year. It grows in ribbons at the edge of rough water, lying plastered together on flat surfaces of the rocks when the sea recedes, the fronds covering one another and so retaining a certain amount of moisture when exposed to the sun and air. The colour is an olive-fawn, very dark when seen in mass and becoming more or less red or purple as the plants are dried. The young plants are narrow and simple. The adult become broad, laciniate with undulate margins, mostly 10 cm. to 15 cm. high. Antheridia are formed from most cells in a male plant, the frond becoming paler and thicker as the sperms develop from the mother cells. Each of these has been observed to form 64, or sometimes 128 colourless sperm cells. The egg cells (carpogonia) are without a trichogyne. When fertilized each divides into eight spores without the aid of an auxiliary cell.

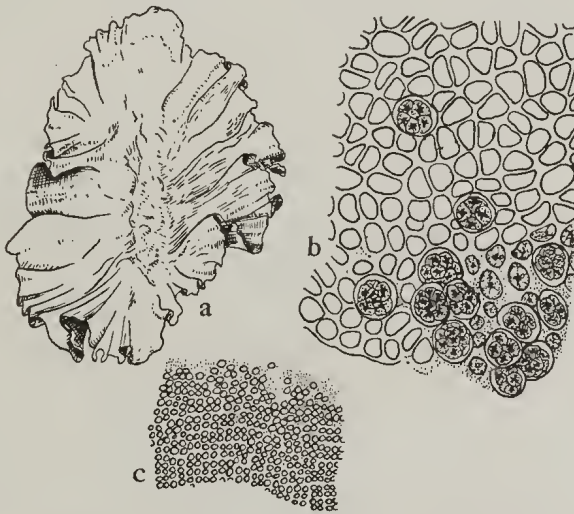


Fig. 6.—*Porphyra umbilicalis*: a, habit of a plant, x 1; b, portion of a blade, showing cell arrangement, chromatophores, and carposporangium arrangement, x 160; c, portion of blade, showing spermatangium formation at the margin, x 160. (After Taylor.)

The monosporangia (gonidia) each form a single monospore. Very little is known about them, but they seem to take the place of the tetrasporangia of the higher Red Algae.

Porphyra furnishes a plentiful supply of food to people in quite distant regions of the globe. In Scotland, Wales, and Ireland it is regarded as a delicacy. The name given to it is Laver, and the baking of Laver bread is not unknown even in Sydney. In Honolulu, China, and Japan systematic use is made of *Porphyra*. A very tender rosy species *P. tenera*, is actually cultivated on a large scale in Japan. Tilden states that in 1901 the cultivated sea-bottom in Japan extended to 2,242 acres. She quotes Hugh M. Smith, who has written a full description of the industry in Tokio Bay. In 1903 the yield was valued at 300,000 dollars. The number of families engaged in the work was estimated at 4,395. Smith's work was published in 1905.

“In October and November the grounds around Tokio Bay are prepared for the seaweed crop. At low tide men go out in small boats with bundles of bamboo prepared for the purpose. In order to make holes in water up to 10ft. or 15ft. deep at high tide, conical wooden boxes or frames are pushed down into the muddy bottom, then the bundles of bamboo are ‘planted’ or set out in these holes, with the result that at low tide the ‘field’ appears to be covered with bamboo ‘bushes’ in regular lines, like rows of corn in a cornfield, only there is much more space between rows.

“It is known that the spores of *Porphyra* float in the water before dropping down and becoming attached to some object. Here they attach themselves to the twigs of the bamboo bushes and develop so rapidly that by January they have grown into full-sized plants. Now it is the turn of the women and girls who finish the business of harvesting the crop. They paddle up and down between the rows of bushes in small boats and with the delicate methods of tea-pickers carefully gather the choice rose-red fronds from the bamboo twigs.

“The fresh red fronds of *Amanori* picked from the twigs are thrown into tubs of fresh water and stirred with long sticks in order to remove the sand and other foreign substances. The plants are then sorted, chopped with sharp knives into fine particles, and spread out in sheets of a uniform size on bamboo mats placed on inclined frames in the open air. In a short time the *Amanori* sheets are dry. To get them ready for the market they are stripped from the mats, pressed, and then made into bundles of ten sheets each, the dimensions being approximately 10in. by 14in. The sheets have the appearance of dark-brown mottled paper with a glossy surface, and in this form they are sold to the consumer under the name of ‘Asakusanori.’ ”

I have thought it well to quote this account of a unique industry, the cultivation of an alga in enclosed sea-waters to furnish human food on a large commercial scale. Unfortunately, I do not know localities where it could be practised in Australia.

Subclass EUFLORIDEAE.

CONSPECTUS OF THE ORDERS.

Nemalioninae.

Fertile carpogonial cells evolving into the gonimoblasts, which form erect branching tufts, sometimes laterally expanded. Gonimoblasts themselves sometimes confluent with contiguous cells of the thallus or with auxiliary cells.

Gigartininae.

Fertile carpogonial cell or short processes fusing with the auxiliary cell, so that the gonimoblast filaments evolve inwards from the fusion cell so formed. Carpogonial filaments articulate and auxiliary cells binate, mostly formed in a procarp proper, rarely occurring singly in the thallus.

Rhodymeninae.

Fertile carpogonial cell or short processes fusing with the auxiliary cell, so that the gonimoblast filaments evolve towards the exterior region of the thallus from the fusion cell so formed. Carpogonial filaments articulate and auxiliary cells binate, usually formed in a procarp proper.

Cryptoneminae.

Fertile carpogonial cells situated within the thallus, emitting elongate filaments, often branched, the terminal or intercalary cells fusing with auxiliary cells. Gonimoblasts evolving from the fusion cell so formed, inwards or outwards. Carpogonial filaments and auxiliary cells formed singly in the thallus.

Order **NEMALIONINAE.**

CONSPECTUS OF THE FAMILIES.

Helminthocladiaceae.

Gonimoblast consisting of a crowded convex bunch of articulated branching threads, free or held together by gelatine, the terminal cells transformed into spores. The gonimoblast external to or immersed in the thallus, lacking a pericarpial covering, sometimes accompanied with protective filaments. Sporangia mostly monosporous, sometimes triangularly divided.

Chaetangiaceae.

Gonimoblast consisting of a crowded convex or umbellately expanded bunch of articulated threads, the terminal cells transformed into spores. Gonimoblast immersed in the thallus, provided with a solid pericarp. Sporangia cruciately or triangularly divided.

Gelidiaceae.

Gonimoblast consisting of a cluster of widespread branching threads, often becoming confluent with quasi-auxiliary cells of the thallus. The apices of the fertile branches confluent in a hymenium, from which the spores arise. Sporangia cruciately, zonately, or triangularly divided.

Family **HELMINTHOCLADIACEAE** (Harvey) Schmitz.

Frond filiform, terete, variously branching, mostly gelatinous, slippery. Structure eminently filamentous with a central axis and radiating cortical threads.

CONSPECTUS OF THE GENERA.

- a. Carpogonia terminal on the younger branches of the cortical threads *Nemalion*
Targioni Tozzetti.
- b. Branches of the carpogonia in the joints of the cortical threads:—
 - (1) Threads of the medullary stratum lax . . . *Helminthocladia*
J. Agardh.
 - (2) Threads of the medullary stratum dense and firmly compacted *Helminthora*
J. Agardh.
 - (3) Threads of the medullary stratum combined in a dense fasciculus. Cortical threads slippery. Plants more or less encrusted with carbonate of lime . . . *Liagora*
Lamouroux.

NEMALION Targioni-Tozzetti 1818.

Frond terete or slightly compressed, soft and slippery, simple or furcately branched, composed of an axis of closely interwoven filaments surrounded by a zone of loose, anastomosing branched filaments, giving off lateral di- or trichotomous corymbose fascicles of peripheral chromatophore-bearing moniliform filaments. Spermatangia hyaline, near the apices of modified peripheral filaments. Carpogenic branches terminal as divisions of the peripheral filaments, immersed, usually three-celled, the upper forming the carpogonium; gonimoblasts formed from the upper of two cells formed after fertilization, the lower cell fusing with the rest of the carpogenic branch to form a nutritive cell; gonimoblasts radiating in a spherical mass, the end cells producing carpospores.

Nemalion helminthoides (Velley 1792) Batters.

= *Nemalion lubricum* Duby.

Thallus simple or once divided at the base, 5 cm. to 20 cm. long, 1 mm. to 4 mm. broad; very elastic, firmly gelatinous, brown or reddish-brown. Thallus structure typical for the genus; cells of moniliform assimilating filaments elongate-ovoid, with gelatinous sheath, 14 to 24 μ long by 7 to 15 μ broad. Carpospore masses just immersed in periphery of thallus, spherical, 60 to 80 μ across; carpospores spherical to ovoid, 4 to 8 μ across.

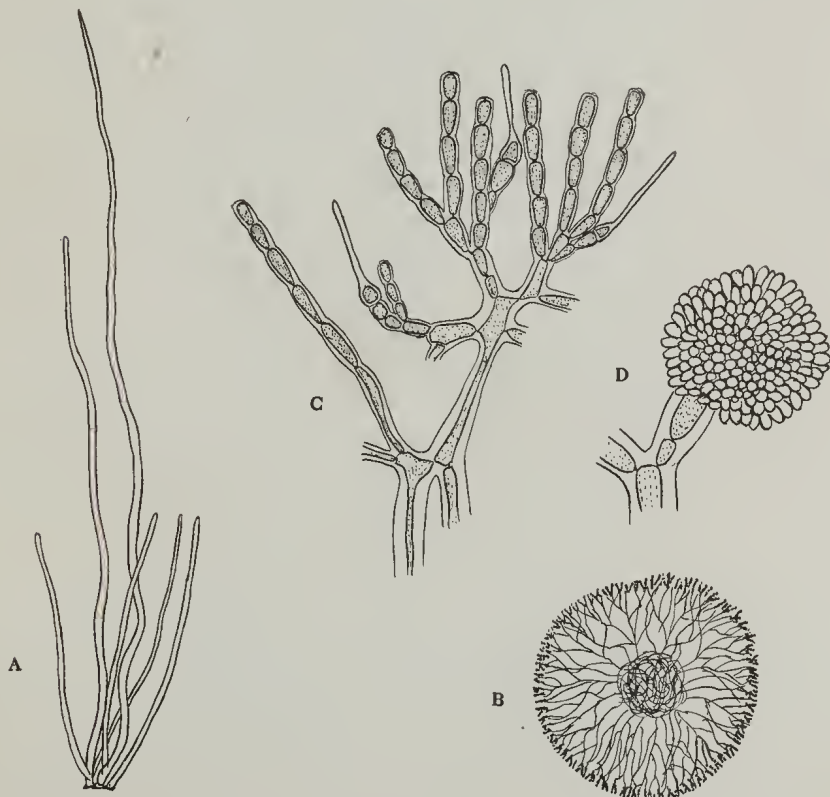


Fig. 7.—*Nemalion helminthoides* (Velley) Batters. a, Adult thallus; b, transverse section of thallus, showing central core and peripheral branched filaments; c, peripheral moniliform filaments, with carpogonia and trichogynes; d, carposporangial mass. Fig. H.B.S.W.

Granite Island, Victor Harbour; growing as isolated plants on granite rocks in spray zone, on the south side of the island.

Britain, Europe.

Nemalion multifidum (Weber & Mohr 1804) J. Agardh has recently been recorded for New South Wales. (Linnean Society of N.S.W., 70, p. 121 (1946).) This species is distinguished by its dichotomously branched thallus, but as all gradations in branching, from simple to several times dichotomous, exist, separation of two species is doubtfully valid. If only one species is accepted, *N. helminthoides* takes priority over *N. multifidum*.

HELMINTHOCLADIA J. Agardh.

Frond terete, gelatinous, slimy, branching in all directions. A medullary axis of longitudinal threads; the periphery of vertical, dichotomous, moniliform, sub-free. Cystocarps as in *Nemalion*. Tetrasporangia not known.

Helminthocladia australis Harvey.

Attached by a small disc, densely tufted, 10 cm. to 30 cm. high, and as much in the spread of the branches. A main stem serves as a percurrent axis

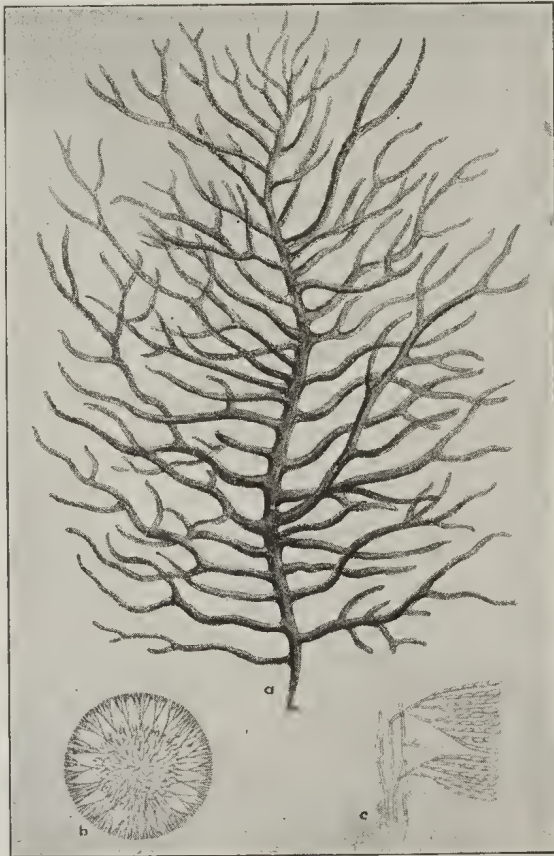


Fig. 8.—*Helminthocladia australis*: a, the plant; b, cross-section of a branch; c, partial longitudinal section, showing the arrangement of the axile threads, and those of the periphery. (After Harvey.)

and bears on all sides long worm-like branches tapering at the tips. Colour a dull brownish-purple. Substance tough and elastic, very soft.

Especially from Western Australia.

Helminthocladia densa (Harvey) Schmitz.

Frond with main terete stem, robust, irregularly forked, the stem and branches emitting slender, many times dichotomous, divaricating ramuli; all the axils very wide. Height 15 cm. to 20 cm. and with an equal spread. Colour very dark brown-red, often blackening when dry. Substance very soft, highly elastic and lubricous.

Victoria and Tasmania.

ENDOSIRA J. Agardh.

J. Agardh described a form gathered by Miss Hussey at Port Elliot as the foundation of a new genus. The peculiarity seems to be in the "cutis," composed of two orders of cells, one of rounded oblong cells, apparently empty, spaced out forming spheres around the central cell; the others coloured, occupying intercellular spaces, and joined in jointed threads. Agardh does not connect or contrast it with the other genera of the family.

Endosira australis J. Agardh.

Frond 7 cm. to 10 cm. tall, about a mm. thick. Inferior branches spreading, middle sub-corymbose racemose, upper enclosed in mucus.

South Australia (Port Elliot).

HELMINTHORA J. Agardh.

Frond terete, gelatinous, branching on all sides, with central axis of longitudinal fibres and a cortex of radiating vertical threads. No pericarp; the carpospores are borne in the swollen cells of the peripheral or vertical threads. Tetrasporangia not known.

Helminthora tumens J. Agardh.

Frond terete, becoming much thickened below, decompound pinnate. Peripheric threads short, elevate, with nearly globose terminal joints.

Victoria.

Considered by Harvey as identical with the European *H. divaricata* but separated by Agardh because of its more robust growth.

LIAGORA Lamouroux.

Frond terete or compressed, mostly dichotomous, but also laterally branched, distinguished by a calcareous deposit in the outer parts. When decalcified manifests the general structure of the family, axial longitudinal branching and intricate fibres, cortical radiating polydichotomous articulated threads. Cystocarps evolved among the peripheric threads, consisting of a fasciculus of pregnant threads. Tetrasporangia in node-like swellings of the upper part of the frond, irregularly cruciately divided. Young parts lubricous. Older parts white with calcareous deposits but not stiff and brittle as the Corallines.

The species of *Liagora* are very difficult to classify, as they show much variation in habit and the degree of incrustation. Abundant in tropical seas they also occur along our southern coast.

The following species are most likely to be met with in South Australia. They grow on reefs about low water mark.

Liagora Cliftoni Harvey.

Frond cartilagino-carnose, scarcely calcareous, terete, dark brownish-purple, many times forked, fastigiate, tomentose; superficial filaments once or twice forked, coloured, cylindrical, articulated, the joints one and a half times as long as broad. Fifteen cm. to 20 cm. tall, 2 mm. to 4 mm. broad.

From Western Australia to Victoria.

Liagora Cheyneana Harvey.

With but little calcareous deposit; frond gelatinous, compressed, dichotomous with additional lateral branches. Branches erecto-patent, silvery, clothed with a purple tomentum. Peripheric filaments free, cylindrical, forked. Seven cm. to 15 cm. long, 1 mm. to 2 mm. in diameter.

Western Australia (Cape Riche) and probably along the Great Australian Bight.

Liagora Harveyana Zeh.

Forming rounded mats from 5 cm. to 10 cm. in diameter. Altogether many times dichotomous, the segments growing slenderer as they radiate. No lateral branches. Hard with impregnation of carbonate of lime. Apices acute. The cortical threads slender, with cylindrical cells, the terminal subrounded or sub-clavate.

All around the southern coast of Australia and northern Tasmania.

Liagora Wilsoniana Zeh.

Main branches persisting through the frond, three or four times dichotomous, with short lateral branches spaced along the axis, these mostly undivided, about half an inch long. All branches compressed. Cells of the cortical filaments equal, oblong, the terminal shorter. About 12 cm. tall. Rather harsh with incrustation.

Victoria and Tasmania.

Family CHAETANGIACEAE Schmitz.

GALAXAURA Lamouroux.

Frond cylindrical or compressed, subtubulose, impregnated with carbonate of lime. Two strata of cells, the tube occupied by longitudinal hyaline fibres, and the peripheric stratum consisting of shorter subvertical cells, gradually becoming 5 to 6-angled and coalescing in an areolate membrane. Cystocarps suspended below the surface, often seriate in transverse

bands, globose, formed of dichotomous threads radiating from a centre, bearing carpospores in the terminal joints. Tetrasporangia cruciately divided.

Galaxaura dolicarthra J. Agardh.

A handsome plant, 10 cm. or more in height and spread, densely-branched, regularly forked, or ternate, corymbose, at first pink then whitening. Frond in bold joints separated by stipitate supports. Calcareous crust firm.

From West to East along southern Australia from Geraldton to Sydney.

Family GELIDIACEAE.

Frond terete or compressed, laterally branched, with a distinct articulated central tube, showing a filamentous structure. Gonimoblast consisting of a clump of spreading filaments, often confluent with special auxiliary cells of the thallus, the apices of the fertile filaments confluent in a membrane from which the carpospores arise. Tetrasporangia variously divided.

There are two sub-families of the Australian forms, which are in marked contrast in contours and in structure; the *Wrangeliae* comprising the genus *Wrangelia*, and the *Gelideae* containing the closely related genera *Gelidium* and *Pterocladia*.

WRANGELIA C. Agardh.

Frond erect, terete-filiform with a conspicuous monosiphonous articulated axis with long joints, naked or covered with a cortex, decompound branching, verticillately ramellose at the nodes. Cystocarps terminal at the apex of a ramulus, involucreted by a whorl of ramelli, and consisting of a tuft of naked pear-shaped pedicellate spores and slender paranemata. Tetrasporangia borne on the sides of whorled ramelli, globose, with a hyaline envelope, triangularly divided. Of the 24 named species 20 are Australian; thus Australia is the headquarters of this beautiful genus. They are all found in the temperate seas of the south. Already seven species have been recorded for South Australia, and others may well be anticipated.

A.—*Armatae*.

Ramuli of the verticils rather rigid, more or less diverging, mucronate with a sharp terminal joint.

a. Fronds from the base articulate, ecorticate.

Wrangelia nitella Harvey.

The slenderest species, frond flaccid, pellucidly jointed throughout, decompound pinnate, branches mostly opposite, with whorled ramelli at the nodes. Ramelli di-trichotomously multifid, divisions very patent and very acute. Tetrasporangia globose, sessile on the ramelli. Height 5 cm. to 9 cm., colour a clear, deep, crimson-lake.

Western Australia.

Wrangelia mucronata Harvey.

Stiffer and harsher than the preceding, the verticils spaced apart, but closely appressed. The ramelli once trichotomous, the

joints many times longer than their diameter, the terminal joint forming a strong mucro. Tetrasporangia numerous, globose, sessile on the ramelli. Height about 10 cm.

Victoria and Tasmania.

- b. Fronds from the base ecorticate, but girdled below by a spongy stratum formed by the ramelli curving downwards from verticil to verticil.

Wrangelia myriophylloides Harvey.

Frond rigid, sparingly pinnately branched, ramelli repeatedly trichotomous, the subdivisions ending each in three oval cells, each tipped by a minute acuminate apical cell. Joints of ramelli constricted at the nodes. Ten cm. to 12 cm. high.

Western Australia and South Australia (Encounter Bay, Investigator Strait, Robe).

- c. Fronds corticate far upwards from the base.

Wrangelia velutina Harvey.

Fronds cartilaginous, corticate, diffusely much branched, branches horizontally patent, once or twice compounded; the

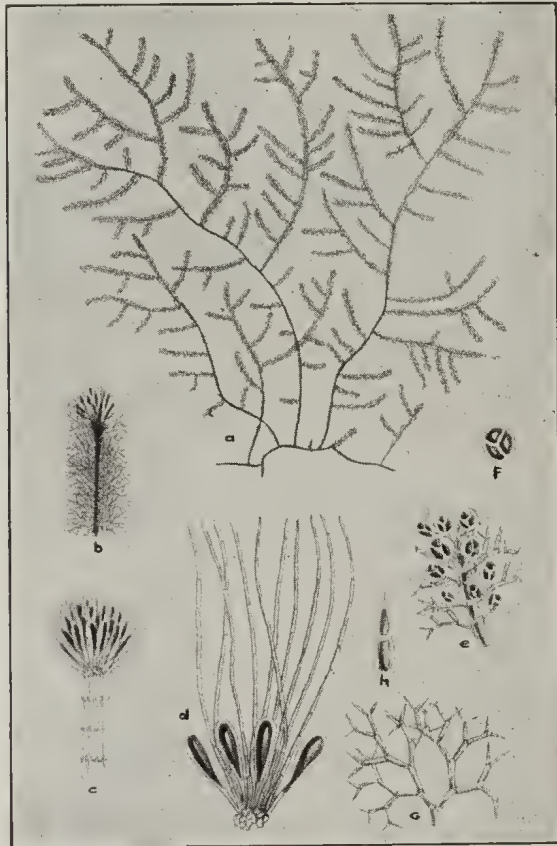


Fig. 9.—*Wrangelia velutina*: a, plant; b, apex of a branch, clothed with ramelli, and bearing a cystocarp; c, part of same with ramelli removed and cystocarp present; d, spores and paranemata; e, portion of a ramulus, with tetraspores; f, tetraspore; g, ramellus; h, mucronate apex of one of the divisions. (After Harvey.)

younger ones densely whorled with minute ramelli; ramelli dichotomo-multifid, with patent axils and sharply acute apices. Cystocarps terminating short branches. Tetrasporangia numerous, sessile on the ramelli. Height 7 cm. to 15 cm., colour a deep brownish-red.

Western Australia, South Australia (Encounter Bay, Robe), Victoria.

B.—*Plumatae*.

Ramelli of the whorls pinnate or dichotomous, rather rigid, patent or incurved, passing from a thicker base into an obtuse apex.

a. Fronds from the base articulate, ecorticate.

Wrangelia protensa Harvey.

Fronds 15 cm. to 30 cm. long, excessively and densely branched; the principal branches long and virgate, several times compound; the ultimate branches 2 cm. to 5 cm. in length, simple, attenuated.

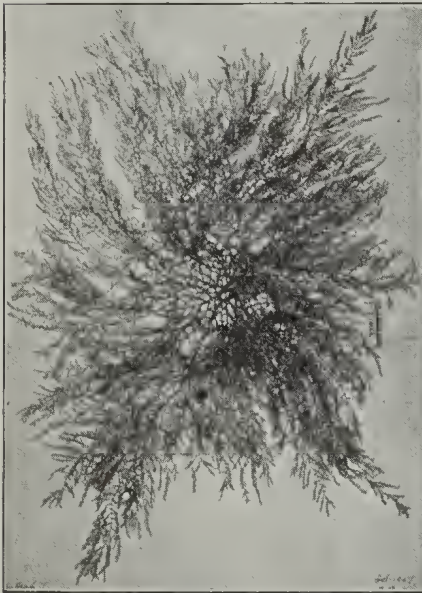


Fig. 10.—*Wrangelia protensa*.



Fig. 11.—*Wrangelia verticillata*.

All the branches and their divisions are very erect. The older parts of the frond, though pellucidly articulate and ecorticate, become shaggy with stupose filaments, which issue from the dissepiments, and are deflected downwards like rootlets. Every articulation of the branches and ramuli bears a pair of opposite ramelli, very erect or appressed, simple or branched from the base, often pinnulated in the lower part, but always with a long excurrent point. Tetraspores scattered on the pinnulae of the ramelli. Substance soft and gelatinous. Colour a rosy-red.

Tasmania, Victoria.

Wrangelia halurus Harvey.

Frond flaccid, membranaceo-gelatinous, irregularly branched, branches sub-simple, tapering, whorled at each node with ditrichotomous, incurved, imbricated ramelli; articulations of the stem three to four times and of the ramelli, cylindrical, 10 to 12 times as long as the diameter. Cystocarps terminating short branches. Tetrasporangia pedicellate, clustered round the joints of the ramelli. Height 7 cm. to 15 cm. Colour dull-brown. Usually epiphytic on *Cymodocea*.

Western Australia, Victoria, and South Australia (Encounter Bay and Investigator Strait).

Wrangelia verticillata Harvey.

Fronds ecorticate but girt below by a spongy stratum of threads joining the verticils. Sub-pinnately decomposed. The sub-confluent verticils often shorter than the internodes, the joints of the ramelli six to eight times longer than the diameter.

From Western Australia through South Australia (Eastern Bays) to Victoria and Tasmania.

Wrangelia crassa Hooker and Harvey.

Fronds ecorticate but girt below with a sponge of the sub-confluent ramelli, the spongy coat longer than the internodes, sub-pinnately decomposed; ramelli of the whorls incurved, cylindrical, obtuse, the joints three to four times as long as the diameter.

West and South coasts of Australia and Tasmania.

Wrangelia Wattsii Harvey.

Frond rigid, sub-dichotomous; stem and branches clothed with deflexed or decurrent filaments, and whorled at the nodes with erecto-patent ramelli; joints of the ramelli three to four times as long as broad; apices obtuse. Harvey says that in *W. crassa* each articulation has a long narrow endochrome, set in a very wide margin of gelatinous cell-wall; in *W. Wattsii* the endochrome fills up the whole space, and the cell-wall is thin and membranous. Seven cm. to 15 cm. high. Dull-brown.

South Australia (Port Elliot, Eastern Bays) and Victoria.

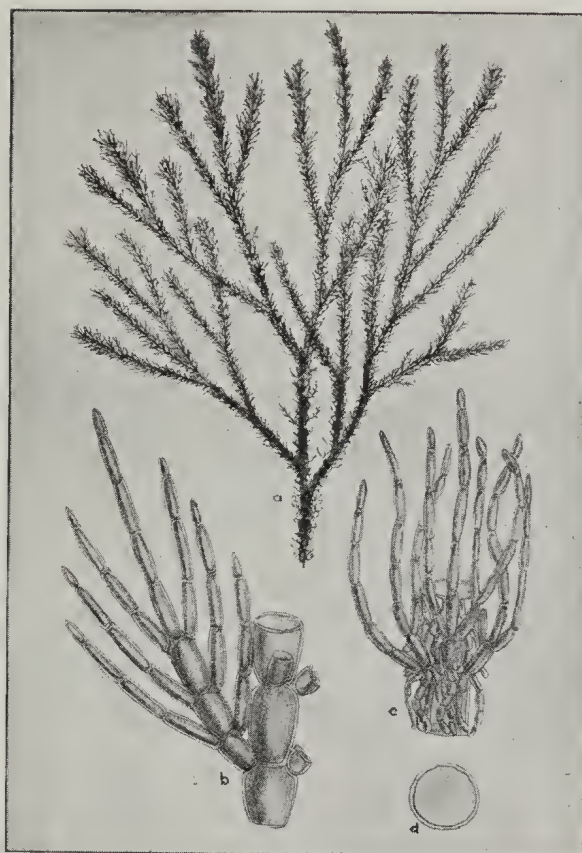


Fig 12.—*Wrangelia Wattsii*: *a*, plant; *b*, pinnated ramulus or plumule; *c*, fragment of an old branch with whorled ramuli and deflexed radicular filaments; *d*, section of a branch. (After Harvey.)

b. Fronds corticated from the base up.

Wrangelia clavigera Harvey.

One of the coarsest; frond cartilaginous, thick, decompound pinnate, throughout densely whorled with imbricate multifid ramelli, the younger branches markedly club-shaped. Ramelli alternately pinnato-multifid, the apices acute. Cystocarps terminating short club-shaped pinnules. Height 15 cm. to 30 cm. Colour reddish-brown.

Spencer's Gulf to Western Port, Port Elliot, Eastern Bays. In Tasmania an allied form with richly pencilled and rosy branches grows to a height of a meter or more.



Fig. 13.—*Wrangelia clavigera*: a, plant; b, ramellus; c, one of the short, club-like fruit branches, bearing a terminal cystocarp; d, spores and paranemata from the cystocarp. (After Harvey.)

Wrangelia nobilis Hooker et Harvey.

Fronds 15 cm. to 30 cm. long, corticated from base upwards, branches patent, irregularly pinnate. Young fronds are clothed with very delicate rosy-red ramelli, 4 mm. in length, giving a feathery character to the branches; this tomentum is close pressed and silky. In older fronds the rosy ramelli become much less abundant, and eventually are confined to the tips of the smaller ramuli, while the tomentum becomes more shaggy and uneven. Finally the rosy ramuli fall off entirely, and at this stage the fruits are produced. Cystocarps typical for the genus, borne on longish pedicels issuing from the older branches. Tetraspores densely aggregated in grape-like clusters, surrounded by involueral ramuli, borne on little pedicels rising from the branches.

Tasmania.



Fig. 14.—*Wrangelia nobilis*.

Fig. 15.—*Wrangelia balloides*.

Wrangelia balloides J. Agardh.

Fronds to 40 cm. high, corticate with dense filaments from the base; pinnately branched, with verticillate ramelli at the nodes; vegetative branches plumose, with the verticils distinct, approximating; verticils of branches heteromorphic, the one long, subdistichous, diverging, alternately pinnate and much branched, the other short, leaf-like on both sides; above incurved, subconverging, cylindrical; all apices obtuse, slightly attenuated; articulations of ramelli about three times as long as broad. Tetraspores on upper incurved ramelli, triangularly divided.

Tasmania.

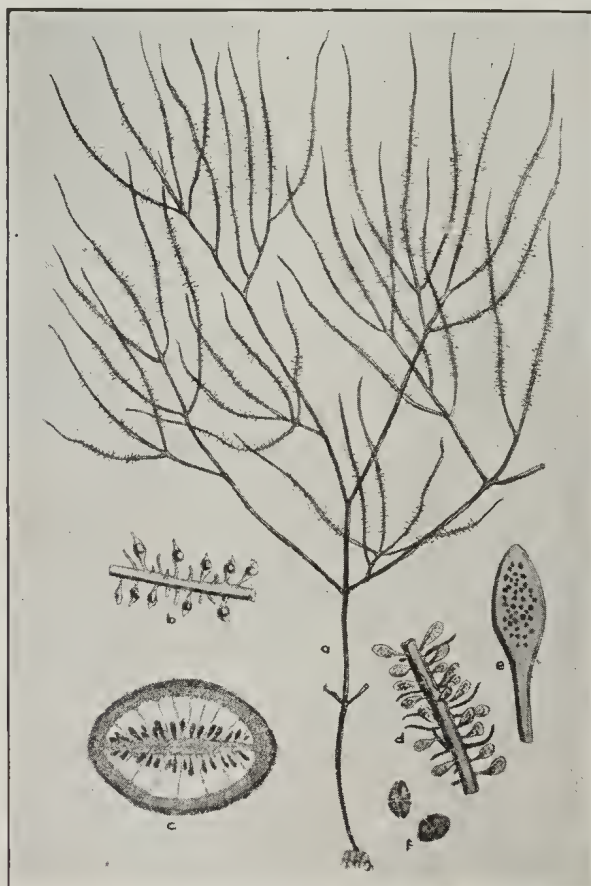
Fig. 16.—*Wrangelia plumosa*.Fig. 17.—*Gelidium australe*.

Fig. 18.—*Gelidium glandulaefolium*: a, plant; b, part of a pinnule, with conceptacles in the bristle-shaped ramuli; c, section of a conceptacle, showing spores attached to the medial dissepiment; d, part of a ramulus, with tetraspores immersed in the dilated ramuli; e, a ramulus, with its sorus of tetraspores; f, tetraspores. (After Harvey.)

C.—*Penicillatae*.

Ramelli of the verticils elongate, dichotomous, very soft and collapsing, joined at the apices of the branches to form a pencil or brush, gradually becoming denuded below. Fronds corticated upwards.

Wrangelia plumosa Harvey.

Much expanded laterally, with long compound pinnate branches very soft when growing, but becoming denuded and rough. Ramelli brush-like, repeatedly dichotomous, very soft, obtuse ending; joints of ramelli contracted at the nodes, many times as long as broad. Height 15 cm. to 30 cm. Cystocarps veiled densely by hairy ramelli. Colour purple but very variable.

New South Wales, Victoria, Tasmania.

Wrangelia princeps Harvey.

The tallest species to 60 cm. high. Frond erect, robust, gelatinous and soft, very easily disintegrated on exposure; pinnae virgate, lanceolate in outline, closely pinnate or bipinnate, the pinnules opposite; nodes of the branches, pinnae and pinnules whorled with byssoid ramelli, ramelli dichotomous, with very long articulations; apices blunt. Cystocarps terminating short pinnules with scarcely an involucre. Tetrasporangia near the base of the ramelli. Colour purplish.

Western Australia, South Australia (Investigator Strait), Victoria.

GELIDIUM Lamouroux.

Frond firmly cartilaginous, linear, compressed, decompound; composed of three strata; the medullary of densely packed, interwoven, longitudinal filaments; the intermediate of polygonal cells; the cortical of minute, coloured cellules arranged in radiating moniliform series. Cystocarps immersed in the ramuli, within a thick pericarp; pear-shaped pedicellate spores dispersed over both surfaces of a medial dissepiment, which renders the cystocarp bilocular. Tetrasporangia forming sori in dilated ramuli, cruciately divided. From *Gelidium* most of the Agar Agar of commerce is obtained.

Gelidium australe J. Agardh.

Frond densely decompound pinnate, about 4in. to 6in. high and equally spread, pinnules narrowed at the base, often acuminate, the cystocarps and tetrasporangia ciliate in series along the branches. Colour violaceous.

From South Australia (Investigator Strait, Robe, Encounter Bay) to New South Wales.

Gelidium glandulaefolium Hooker and Harvey.

Frond very narrow, distinctly bi-tripinnate; pinnae few, opposite, naked at the base, fasciculately pinnulate above, pinnules very long, filiform, simple or forked. Both cystocarps and tetrasporangia fringe the pinnules. Height 25 cm. to 40 cm. Colour a dark purplish-red.

South Australia (Encounter Bay, Investigator Strait, Robe), Victoria, Tasmania.

Gelidium rectangulare Lucas.

Stem compressed, about 2 mm. wide, naked in lower third, above with long distichously-spreading branches. Height of plant to 30 cm. or more. Rami flat, distichously bipinnate. Ultimate pinnules numerous, opposite, pectinate, arising from the margins of the pinna at right angles, rigid, about 5 mm. long. Tetrasporangia as usual fringing the ultimate pinnules.

Western Australia (Flinders Bay), South Australia (Point Le Hunte and Clare Bay at the head of the Great Australian Bight).

PTEROCLADIA J. Agardh.

Differs from *Gelidium* only in that the cystocarps are unilocular, and thus appear on the one face of the frond only.

Pterocladia lucida (R. Brown) J. Agardh.

Frond 15 cm. to 45 cm. high, plane compressed, thickened in the centre and sharply two-edged, pinnately decomposed. Very variable in the amount



Fig. 19.—*Pterocladia lucida*: a, plant; b, apex of a pinna, bearing conceptacles; c, vertical section of a conceptacle and of the frond; d, apex of a pinna, bearing tetraspores in dilated pinnulae; e, tetraspores. (After Harvey.)

of ramification and in the breadth of the frond, often proliferous. Cystocarps are formed about the middle of the pinnule. The tetrasporangia are formed among the cortical filaments of dilated pinnules. Colour purplish-red. Surface glossy.

Round the coast from Western Australia to New South Wales. Abundant at Lord Howe Island. South Australia (Encounter Bay, Investigator Strait, Eastern Bays).

Order **GIGARTININAE.**

CONSPECTUS OF THE SUBFAMILIES.

Acrotylaceae.

The gonimoblast, the bundle of fertilized filaments which bear the carpospores, closely conjoined with the surrounding tissues, leaving as it were a cavity clothed within by a membrane. Tetrasporangia zonately divided.

Gigartinaceae.

Gonimoblast consisting of a bundle (caespitulum) of branches passing into and conjoined with the surrounding tissues, evolving the carpospores within the complex. Tetrasporangia mostly cruciately divided.

Rhodophyllidaceae.

Gonimoblast divided into several lobes, from auxiliary cells radiating inwards in all directions. Carpospores acrogenous. Tetrasporangia zonately divided.

Family ACROTYLACEAE Schmitz.

ACROTYLUS J. Agardh.

Frond compressed, linear, dichotomous; composed of three strata of cells, the medullary of branching, reticulately-anastomosing slender filaments; the intermediate of roundish-angular cells; the cortical of seriated, coloured

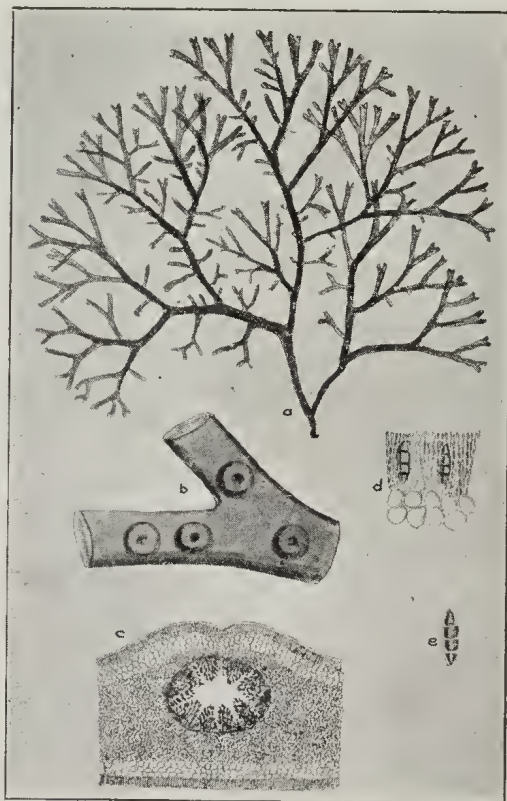


Fig. 20.—*Acrotylus australis*: a, plant; b, portion of branch with conceptacles; c, section through the frond and a conceptacle; d, section through a sorus; e, tetraspore. (After Harvey.)

cells. Cystocarps semi-immersed in the frond, opening by a central pore containing parietal tufts of moniliform spore-threads. Tetrasporangia in defined sori, under the apices of the segments, zonately divided.

Acrotylus australis J. Agardh.

The only species, 6 cm. to 20 cm. high, 2 mm. to 3 mm. wide. The colour brown-red. The substance tough and leathery.

South Australia (Encounter Bay), Victoria, Tasmania.

HENNEDYA Harvey.

Frond flat membranous, dichotomo-laciniate. Composed of three strata of cells, the medullary of densely interwoven narrow threads, the inter-

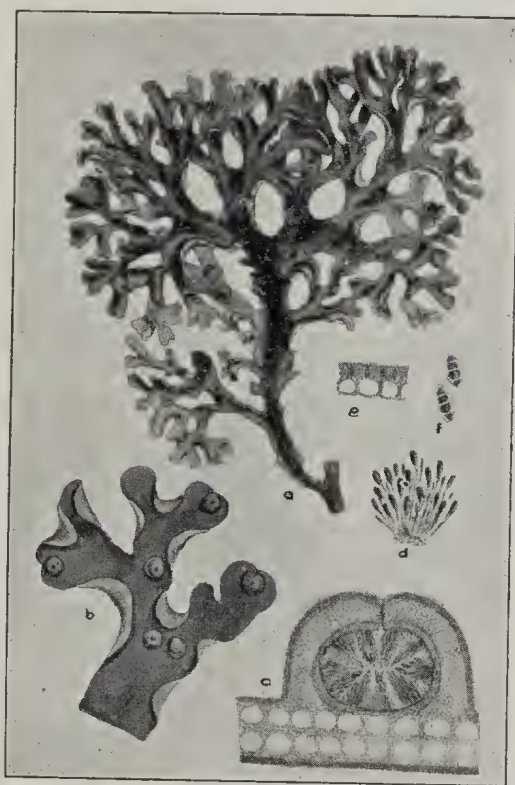


Fig. 21.—*Hennedya crista*: a, plant; b, apex of a segment, with conceptacles under the tips; c, section through the frond, and through a conceptacle; d, tuft of spores; e, section through a sorus; f, tetraspores from the same. (After Harvey.)

mediate of a simpler series of large-squared cells; the cortical of shortened moniliform vertical chains. Cystocarps show a cavity lined with parietal bundles of pregnant cells. Tetrasporangia below the thickened apex of laciniae, zonately divided.

Hennedya crista Harvey.

The only species. Height 15 cm. to 30 cm. Colour brownish-purple.

Western Australia, South Australia (MacDonnell Bay).

Family GIGARTINACEAE Schmitz.

Frond terete, two-edged, flat, foliaceous; dichotomous, much branched, or lobed—in fact with all manner of contours. Composed of two or three distinct strata. Cystocarps prominent or immersed. Gonimoblast forming a clump, the branches of which are conjoined with the surrounding tissues, evolving the carpospores within the mass. Tetrasporangia more often cruciately divided.

CONSPECTUS OF THE SUBFAMILIES.

A.—Thallus traversed by a median axile fasciculus of longitudinal sometimes forked filaments. Thallus endowed most distinctly with a filamentous structure. Tetrasporangia mostly cruciately divided *Gigartineae*.

B.—Thallus most rarely showing filamentous structure.

a. Tetrasporangia cruciately divided. Auxiliary cells situated at the outer limit of the cortex, bearing a three-celled carpogonial branch directed outwards *Tilocarpeae*.

b. Tetrasporangia zonately divided. Auxiliary cells situated in the interior region of the cortex, bearing laterally single or several three-celled carpogonial branches.

1. Structure of frond filamentous-cellular *Mychodeae*.

2. Structure of frond altogether cellular *Dicranemeae*.

c. Tetrasporangia cruciately divided. Auxiliary cells situated in the interior region of the cortex, bearing a single recurved three-celled carpogonial branch and several lateral one-celled branches *Kallymenieae*.

Subfamily Gigartineae J. Agardh.

There are two Australian genera, *Iridophycus* S. & G., a foliaceous form and *Gigartina* of various contours. In *Iridophycus* the cystocarps are immersed; in *Gigartina* they are at length prominent externally.

IRIDOPHYCUS Setchell and Gardner.

Syns. *Iridea* Bory, *Iridaea* J. Agardh.

Thallus membranous-expanded, disc prostrate, below more or less shortly stipitate, stipe simple, expanded into an apophysis; apophysis smooth or verrucose, with one or more dichotomies, not bearing lateral processes, thallus expanded above, slightly membranous to chartaceous; usually iridescent under water; superficially smooth or more or less verrucose,

spinulose or papillose; thallus structure net-like. Cystocarps immersed in the thallus, central or almost superficial, with a common nucleus of many spores more or less distinct. Tetrasporangia in sori of circular outline, everywhere in the frond in a sub-cortical position.

Iridophycus australasica (J. Ag.) comb. nov.

Frond large, to 50 cm. long, stipitate, lanceolate, oval or dilated above, margin entire, slightly undulate or folded, or with small leafy unequal inflations. Cystocarps common, immersed in the frond. Tetraspores cruciately divided, nidulating in sori towards the centre of the frond. Colour purplish-red.

Southern Australia (Robe in South Australia) and Tasmania.

GIGARTINA Stackhouse.

A world-wide genus, with 15 Australian representatives. The contours vary greatly in the different species. The structure shows two strata of cells, the medullary of cylindrical, articulated filaments, anastomosing into a very close network, the cortical of moniliform, vertical, dichotomous filaments set in firm gelatine. Cystocarps external, globose, containing within a mass of closely interwoven filaments, a compound nucleus consisting of many confluent nuclei or masses of roundish-angular spores. Tetrasporangia collected in dense sori lodged beneath the superficial cells. Four species are recorded from South Australia.

Gigartina Muelleriana Setchell and Gardner.

Frond terete, dichotomous-fastigiate, flabellate, segments and pinnules obtuse, solidly cartilaginous. Cystocarps on the flat face of a ramulus, girt by the elevated margin of the pericarp. Sori in the upper segments. Height 8 cm. to 15 cm., 2 to 3 mm. thick. Colour fleshy-yellow. Grows on reefs near low water.

South Australia (Eastern Bays), Victoria, Tasmania.

Gigartina disticha Sonder.

Frond compressed, thick, fleshy, linear, with a few erect main branches and distichous pinnules. Cystocarps said to be solitary in the tips of the pinnules. Sori elongate immersed in the pinnules. Height 20 cm. to 30 cm., width 4 mm. to 5 mm. Colour a livid-purple.

Western and South Australia (Encounter Bay, Investigator Strait, Eastern Bays).



Fig. 22.—*Gigartina disticha*: a, plant; b, cross-section, to show the structure of frond, and an immersed sorus of tetraspores; c, tetraspores. (After Harvey.)

Gigartina crassicaulis Setchell and Gardner.

Frond rather thick cartilaginous, flattened, distichously compound pinnate; ultimate pinnae linear; greater ones flat, attenuated at both extremities. Height 30 cm. or more. Width of the flattened axis to 7 mm. or more. Cystocarps behind the apex of the pinnules, sessile on the flat face. Sori spreading along the borders of the wide axis among the pinnellae. Colour varying a good deal on condition, when freshest a rich brown-purple.

South Australia (Eastern Bays), Victoria, Tasmania.

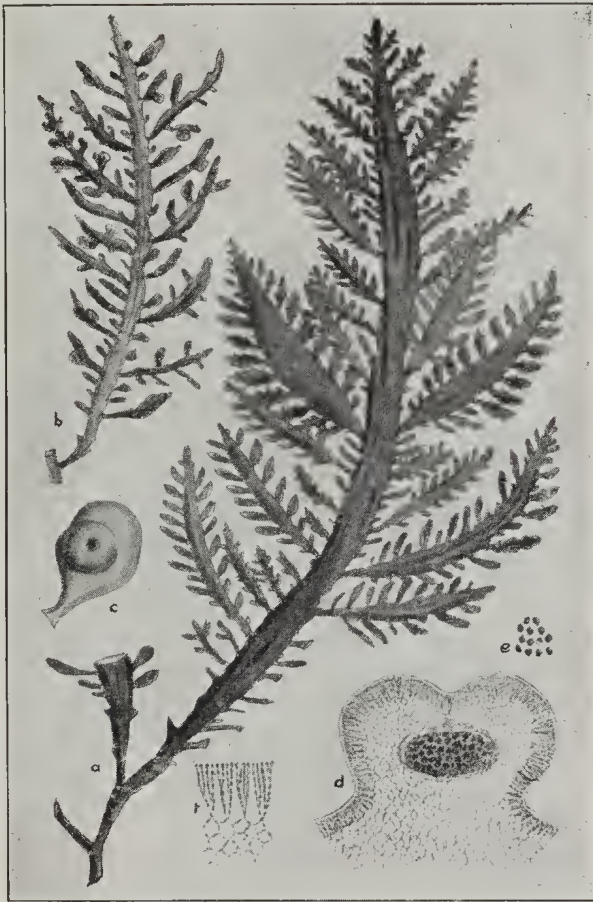


Fig. 23.—*Gigartina crassicaulis*: a, branch; b, fertile branchlet; c, ramulus with conceptacle; d, section through conceptacle showing structure of frond and spores; e, spores; f, portion of cortical layer and medullary network. (After Harvey.)

Gigartina Wehliae Sonder.

A handsome red plant, 4 cm. to 10 cm. high and as much in spread, flabellate-branching, the whole frond girt by a thickened margin. Segments papillose on the margin, never on the disc. Substance fleshy, thick, hardening on drying.

Described by Sonder from plants sent to him from MacDonnell Bay by Mrs. Wehl.

Gigartina gigantea J. Agardh.

Fronds large, stipitate; stipe short, branching, terete but becoming flattened; thallus of young plants obovate to round, in older plants vaguely lacinate or proliferous from the margin, at length much expanded with lacerate laciniae. Tetrasporangia in thallus. Cystocarps superficial, laxly papillose on the margin; sterile papilli long, ligulate, fertile with cystocarps, single, terminal.

Southern Australia (Encounter Bay in South Australia), Tasmania.

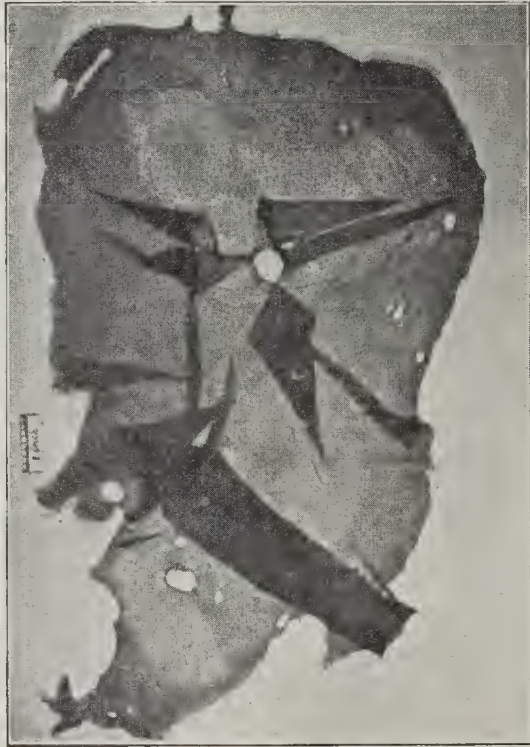


Fig. 24.—*Gigartina gigantea*.

Subfamily Tylocarpeae Kützing.

The genus *Stenogramme* Harvey is the only Australian genus.

STENOGRAMME Harvey.

Frond rose-red, flat, membranous, nerveless, flabellately laciniate, composed of two strata of cells, the medullary of roundish-angular cells in several layers, the cortical of minute coloured cellules. The cystocarps are linear, midrib-like, and contain within a thick pericarp confluent masses of minute spores. The sori of tetrasporangia scattered in blotches over both surfaces of the frond, and ultimately changed into strings of cruciate tetrasporangia in linear series. Both forms of reproduction are unique.

Stenogramme interrupta (C. Agardh) Montagne.

Frond flabelliform. Height 15 cm. to 30 cm. The lines of cystocarps interrupted in each lobe of the frond, sometimes 5 cm. long.

The Atlantic and Pacific, New Zealand, Tasmania, and Australia (St. Vincent Gulf).

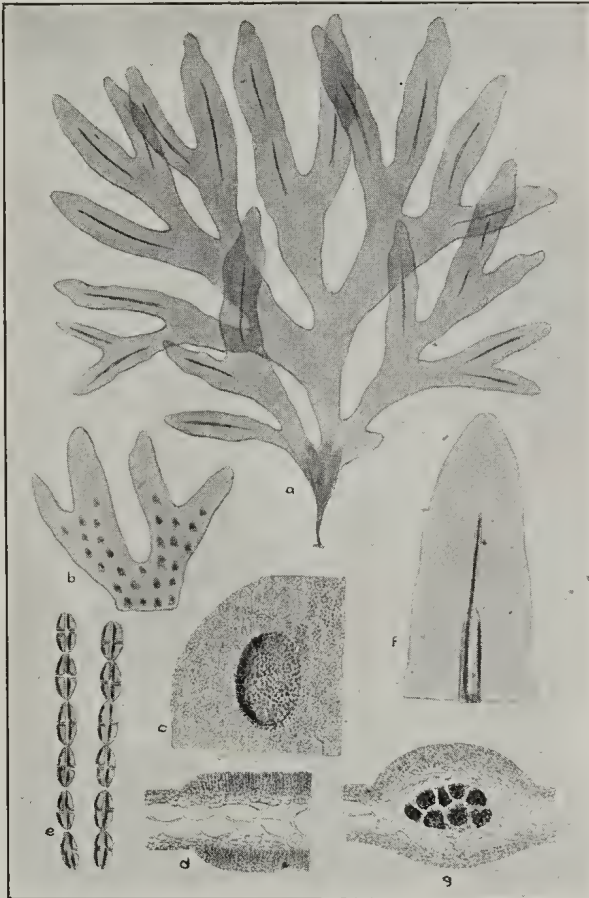


Fig. 25.—*Stenogramme interrupta*: a, plant with linear conceptacles; b, fragment with sori of tetraspores; c, small portion of the frond, with a sorus; d, section through frond and sorus; e, strings of tetraspores; f, portion of frond and conceptacle; g, section through frond and conceptacle. (After Harvey.)

Stenogramme leptophyllum J. Agardh.

Described from Port Phillip Heads; chiefly distinguished by the narrow linear lobes.

South Australia (Encounter Bay, St. Vincent Gulf) and Victoria.

Subfamily Mychodeae Schmitz.

MYCHODEA Harvey.

Frond filiform, cartilaginous, alternately decompound, dendroid, composed of three strata, the medullary of longitudinal and excurrent, interwoven and anastomosing filaments; the intermediate of large, rounded, empty cells, smaller outward; the cortical of minute, coloured, vertically seriated cellules. Cystocarps external, lateral or terminal, containing within a thick-walled pericarp a compound nucleus, consisting of many confluent nucleoli or masses of rounded angular spores. Zonate tetrasporangia dispersed in the branches and ramuli.

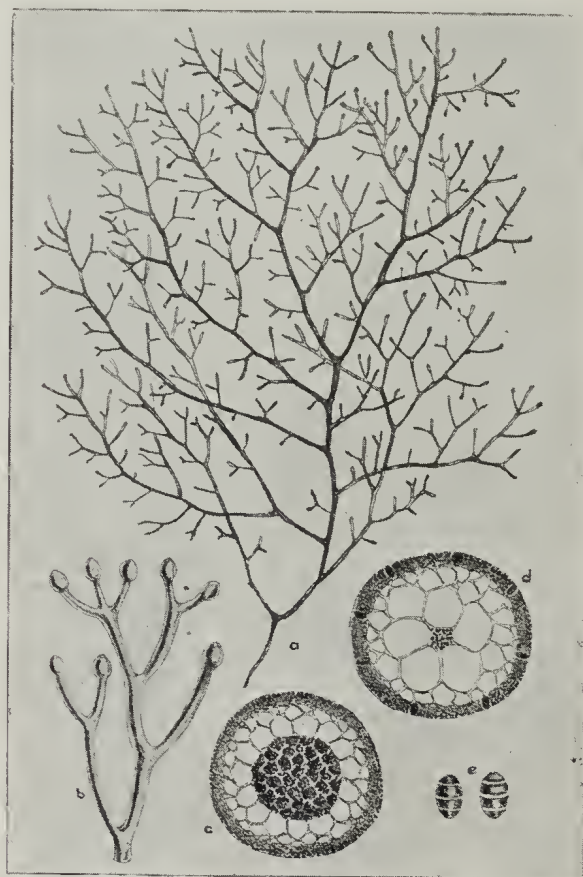


Fig. 26.—*Mychodea terminalis*: a, cystocarp-bearing plant; b, apex of a fertile branch; c, transverse section through a cystocarp; d, transverse section of frond with tetraspores imbedded in the cortical layer; e, tetraspores. (After Harvey.)

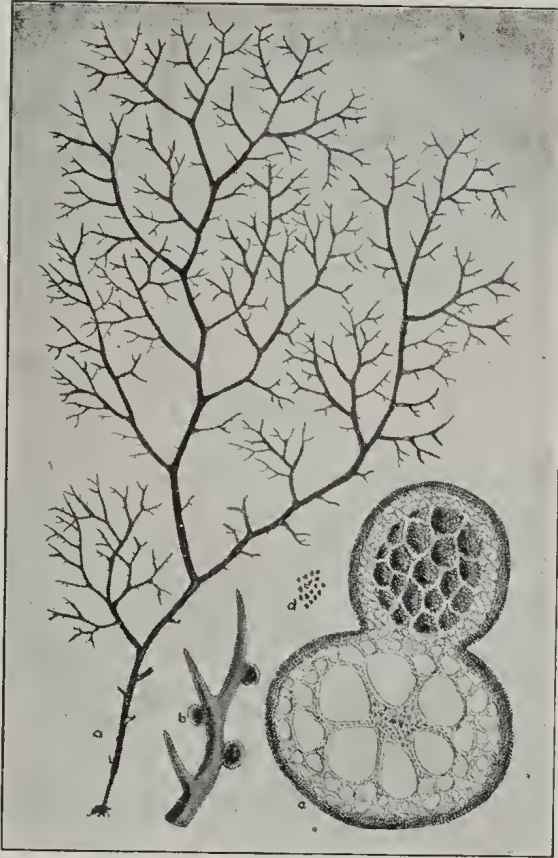


Fig. 27.—*Mychodea carnosa*: a, plant; b, apex of a small fertile branch with three conceptacles; c, cross-section of frond and of a conceptacle; d, spores from the latter. (After Harvey.)

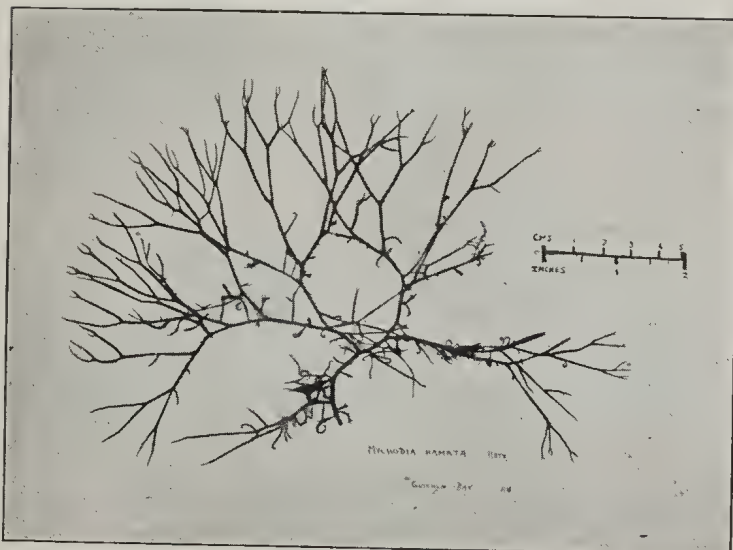


Fig. 28.—*Mychodea hamata*.

A.—Cells of the intermediate stratum very large, the cortical cells in simple vertical series. Frond terete, dichotomous, about 25 cm. high.

1. Cystocarps terminating the ramuli *M. terminalis*
Harvey.
2. Cystocarps occupying the whole of a small
ramulus *M. membranacea*
Harvey.
3. Cystocarps spherical, sessile on the lesser
segment *M. carnosa*
Harvey.

B.—Cells of median stratum large. Cortical cells in dichotomous fastigate series.

a. Frond terete.

4. Dwarf, 5 cm., spreading on all sides *M. pusilla*
(Harvey) J. Agardh.
5. Small, 10 cm., fastigate *M. fastigiata*
(Harvey) J. Agardh.
6. 15 cm. to 30 cm. long. Ramuli lateral, sub-
secund, uncinat, tangled *M. hamata*
Harvey.

b. Frond compressed.

7. 20 cm. to 40 cm. Long sub-distichous pinnate
branches to 10 mm. broad *M. compressa*
Harvey.
M. nigrescens
(Harv.) J. Agardh.
M. disticha
Harvey.

These species are difficult to distinguish and are not satisfactory.

c. Frond flat, linear or euncately dilated, flabellately expanded.

8. *M. foliosa* (Harv.) J. Agardh.

The following species of *Mychodea* have been collected from the localities given below in South Australia:—

- M. carnosa* Harvey. Eastern Bays.
M. hamata Harvey. Encounter Bay, Eastern Bays.
M. compressa Harvey. Investigator Strait, Eastern Bays.
M. nigrescens (Harv.) J. Agardh. Investigator Strait, Eastern Bays.
M. disticha Harvey. Investigator Strait, Eastern Bays.
M. foliosa (Harv.) J. Agardh. Eastern Bays.
M. linearis J. Agardh. Fowler's Bay.

Subfamily Dicranemeae Schmitz.

Comprises the single genus *Dicranema*.

DICRANEMA Sonder.

Frond terete, setaceous, dichotomous, formed of three strata; the medullary of slender, closely-packed, longitudinal filaments; the intermediate of angular cells, smaller towards the circumference; the cortical of vertically seriated, minute, coloured cells. Cystocarps hemispherical, containing within a thick pericarp, pedicellate, obovate spores, attached to a fibro-cellular placenta. Zonate tetrasporangia lodged in the swollen tips of the branches.

Dicranema Grevillei Sonder.

Frond 5 cm. to 10 cm. high, ultra-setaceous, dichotomo-fastigiate; axils widely spreading; apices patent or divaricate. Cystocarps near the obtusely horn-like tip. Pod-like tips erecto-patent.

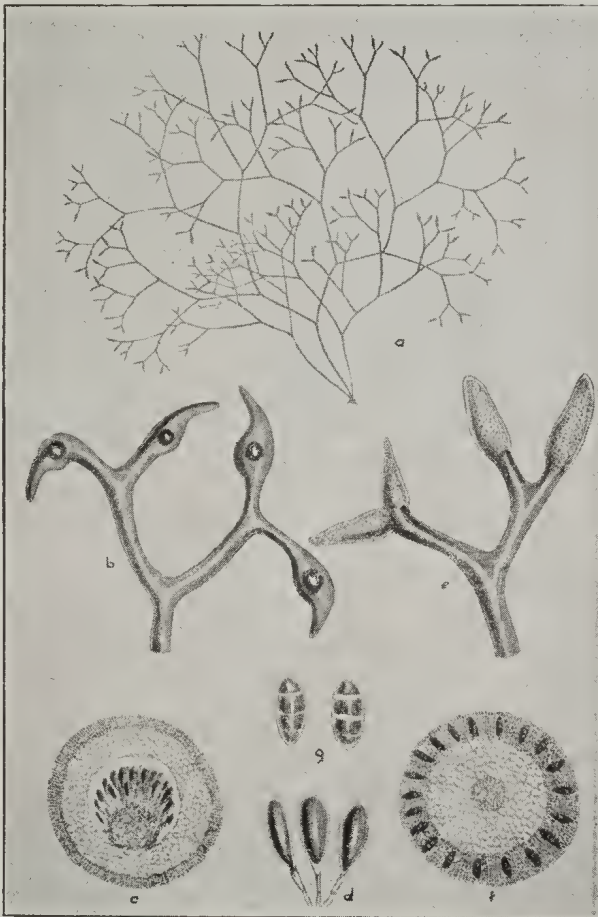


Fig. 29.—*Dicranema Grevillei*: a, plant; b, tips with imbedded conceptacles; c, section of a conceptacle; d, spores from same; e, tips with tetraspores in the dilated extremities; f, cross-section, showing the tetraspores in situ; g, tetraspores removed. (After Harvey.)

Abundant and epiphytic on *Cymodocea*.

West Australia, South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Victoria.

Subfamily Kallymenieae (J. Agardh) Schmitz.

CONSPECTUS OF THE GENERA.

A.—Median (axile) region of the frond cellular.

- a. Cells of the median region arranged in several series. These cells irregularly arranged, separated by meatuses *Callophyllis*
Kützinger.

- b. The largest cells of the median region forming a single series *Polysiphonia*
J. Agardh.

B.—Median region of the frond traversed by thin articulated branching, more or less loose filaments.

- c. Medullary filaments forked, accompanied by rhizoids directed towards the circumference . *Kallymenia*
J. Agardh.

- d. Medullary filaments thin, traversed by single rhizoids *Meredithia*
J. Agardh.

CALLOPHYLLIS Kützinger.

Frond carnose-membranaceous, flat, dichotomous or laciniated, formed of two strata of cells, the medullary of large rounded cells, separated by intercellular meatuses, filled with endochrome, the cortical of vertical moniliform filaments. Cystocarps half-immersed, superficial or marginal, containing within a thick closed pericarp a compound nucleus, consisting of several nuclei or masses of spores. Cruciate tetrasporangia dispersed through the cortical layer.

Callophyllis cervicornis Sonder.

Frond di-trichotomous and then irregularly pinnate, with narrow linear segments, here and there with a subulate simple or bifid tooth, the upper segments secund breaking into teeth or prongs of the horns. Cystocarps immersed in the disc of ultimate laciniae. Height 5 cm. to 8 cm. Colour rose-purple.

South Australia (Encounter Bay).

Callophyllis Harveyana J. Agardh.

Frond dichotomously multipartite, sub-fastigiate, broad, flat and entire at the margin, without teeth. Height 20 cm. to 30 cm. The segments are linear-cuneate, obtuse and from 6 mm. to 10 mm. wide. The cystocarps over the surface of the frond. Colour a brilliant rosy-red. The substance is soft and the plant adheres closely to the paper.

South Australia (Eastern Bays), Victoria, Tasmania.

Callophyllis marginifera J. Agardh.

Frond flattened, thinly membranaceous, like a *Nitophyllum*, decompose pinnate, the pinnae becoming thinner and ultimately very narrow. Rachis 9 mm. to 10 mm. wide. Cystocarps globose, lateral on the margin and often on the apex of a pinnule reflexed over it. Closely adheres to the paper.

South Australia (Fowler's Bay, Eastern Bays).

Callophyllis Lambertii (Turner) Greville.

The tallest and most robust as well as the commonest species. Rising to 25 cm. to 45 cm., the main rachides are 6 mm. to 8 mm. broad, flat, two-edged and stout, the main branches erect and vaguely dichotomous, the side

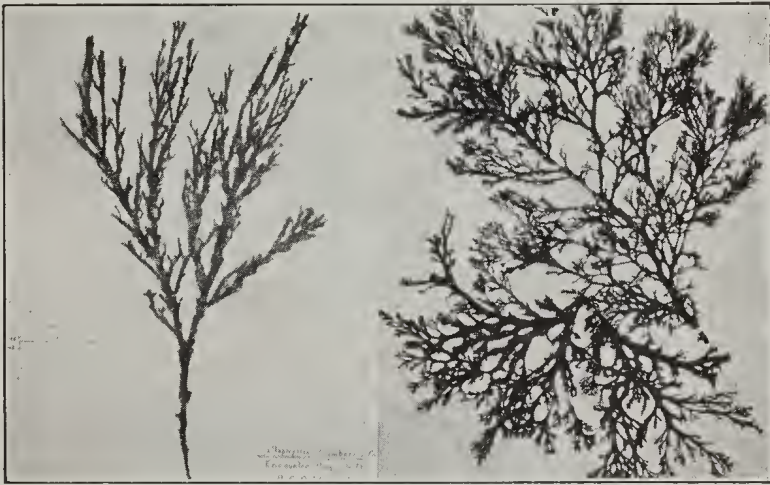


Fig. 30.—*Callophyllis Lambertii*: Two specimens.

pinnae spreading and again breaking into laciniae and teeth. Cystocarps sub-immersed within the apices of the pinnules. Colour deep blood-red. Does not readily adhere to paper.

From Western Australia round to Victoria and Tasmania. In South Australia (Encounter Bay, Investigator Strait, Eastern Bays).

Callophyllis coccinea Harvey.

Frond spreading equally, flattened, two-edged, the main rachides dichotomous or often with several branches approximating, di-trichotomous. The segments becoming slenderer as they pass outwards. Height 8 cm. to 15 cm. The main rachides as wide as in *C. Lambertii*. Cystocarps below the apices of the pinnules. The contours are smoothly corymbose. The colour a beautiful rose, and the plant adheres closely to the paper.

South Australia (Investigator Strait, Eastern Bays), Victoria, Tasmania.

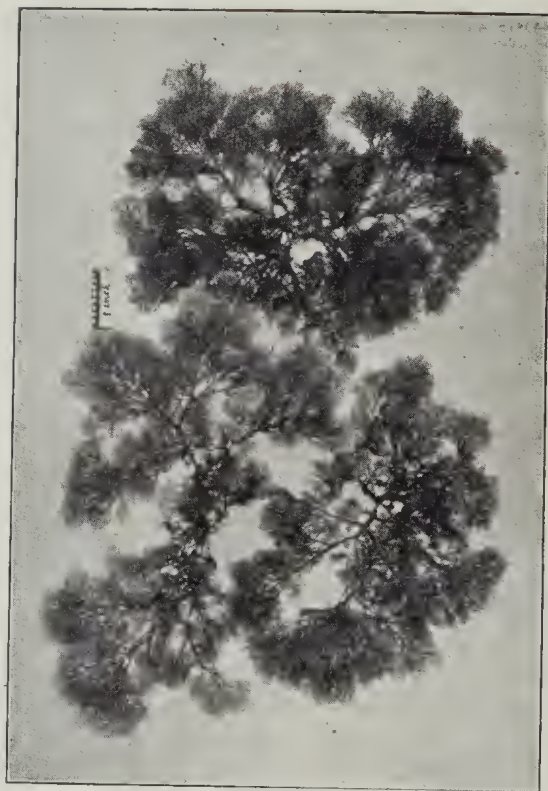


Fig. 31.—*Callophyllis coccinea*.



Fig. 32.—*Polyoelia laciniata*.

POLYCOELIA J. Agardh.

Frond gelatinous-carnose, flat, dichotomous, laciniate or sub-pinnately decomposed, composed of two strata, the medullary of a single layer of very large cells, separated by thick gelatinous walls, the cortical of articulated, densely anastomosing vertical threads. Cystocarps closed, immersed in the frond. Tetrasporangia evolved within the cortical stratum, cruciately divided.

Polycoelia laciniata J. Agardh.

Frond laciniate, palmatifid or sub-pinnate; the segments separated by a wide sinus. Segments 7 mm. to 15 mm. wide. Colour red.

Western Australia, South Australia (Eastern Bays), Tasmania.

Polycoelia chondroides J. Agardh.

Frond thick fleshy, sub-pinnately dichotomous in a flexuous rachis. 7 cm. to 8 cm. high. Colour purple.

South Australia (Waterloo Bay, Eastern Bays).

KALLYMENIA J. Agardh.

Frond widely expanded in a foliaceous membrane, composed of three strata, the medullary of interwoven and anastomosing filaments, the intermediate of large roundish cells, the cortical of minute vertically-seriated coloured cellules. Cystocarps sunk in the frond, containing a compound nucleus, formed of several nucleoli or masses of spores. Tetrasporangia scattered among the cortical cellules.

Kallymenia cribrosa Harvey.

Frond with a short stipe, expanding into a rounded lamina, 30 cm. to 60 cm. long and broad. The frond is always pierced with holes from pin-

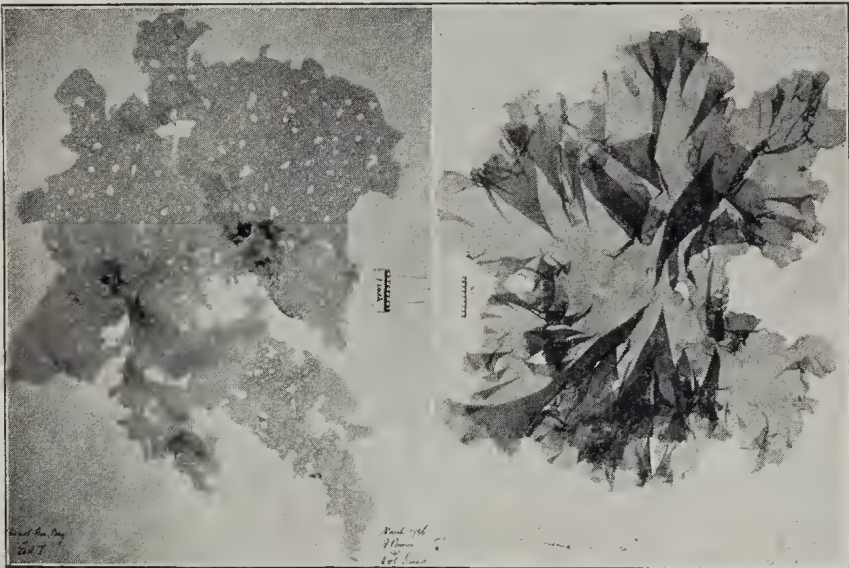


Fig. 33.—*Kallymenia cribrosa*.

Fig. 34.—*Kallymenia tasmanica*.

punctures to circles a cm. in diameter. Colour when fresh a deep crimson-lake, on exposure becoming yellow. Growing in deep water.

Western Australia, South Australia, Victoria, and Tasmania.

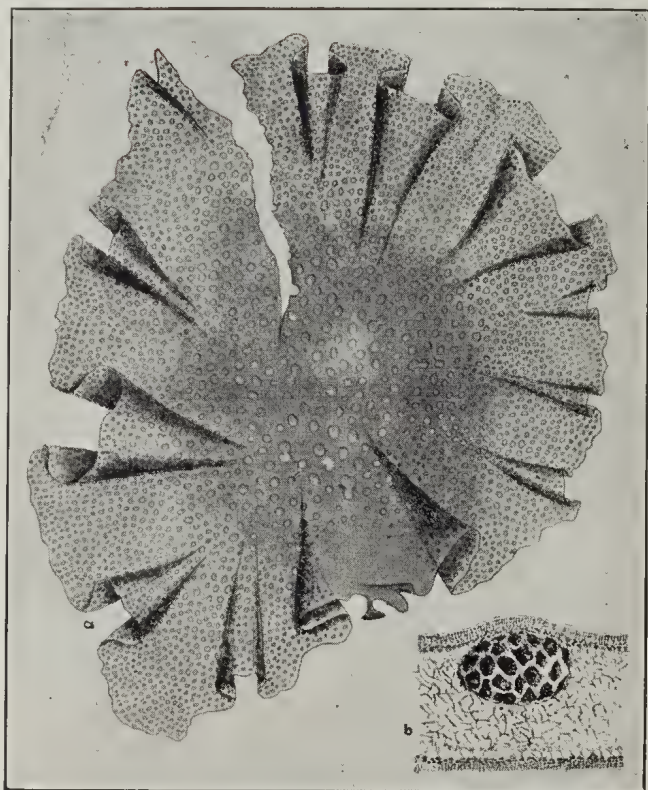


Fig. 35.—*Kallymenia cribrosa*: a, plant; b, section of the frond and of a cystocarp. (After Harvey.)

Kallymenia tasmanica Harvey.

Frond gelatinous-fleshy, shortly stipitate, expanding into a lamina of two or more square feet, generally rounded, oblong in outline, with marginal lobes and laciniae. Not perforated. Purple.

South Australia (Eastern Bays), Victoria, Tasmania, New South Wales.

MEREDITHIA J. Agardh.

Frond fleshy, flat, on a short stipe, rounded-oblong or dichotomous-palmate, with sinuous lobes. Structure much as in *Kallymenia*. Cystocarps immersed above the surface; cup-shaped tetrasporangia immersed in the cortical stratum, cruciately divided.

Meredithia polycoelioides J. Agardh.

Frond stipitate, dichotomous-subpalmatifid, linear sigments below the axils more or less euncate, terminally dilated, subdigitate-lobed, lobes obtuse; axils of adults rounded, proliferous from the margin. Cystocarps immersed in median segments, sparse, often confluent into large round spots.

The Great Australian Bight, South Australia (Gulf St. Vincent, Eastern Bays), Victoria (Port Phillip), and Tasmania.

GELINARIA Sonder.

It is at present doubtful as to the systematic position of this very handsome genus. The cystocarps have not been seen and the embryology is unknown. The general structure, internally tubular with anastomosing filaments and a similar cortex, as well as the cruciate tetrasporangia, seem to show a close relation with *Kallymenieae* and *Cystoelonieae*.

Two species have been described.

Gelinaria ulvoidea Sonder.

Holdfast a fleshy disc, half an inch in diameter. Stipes compressed 2 cm. to 5 cm. long, firmly cartilaginous, expanding into the cuneate base of the frond. Frond 25 cm. to 60 cm. long, and nearly as much in the expansion of the segments, repeatedly and irregularly pinnatifidly divided. The principal segments are 2 cm. to 5 cm. broad, distantly pinnate with linear-lanceolate branches, the tips acute. The colour a rich crimson-lake, and the pigment runs when the plant is placed in fresh water.

Western Australia, probably South Australia.

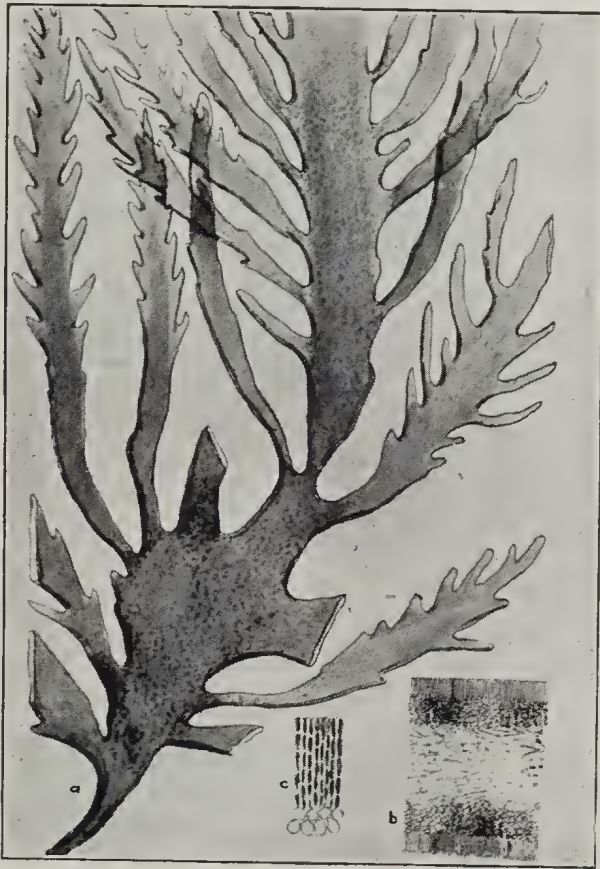


Fig. 36.—*Gelinaria ulvoidea*: a, plant; b, section through the frond; c, minute portion of the cortical stratum. (After Harvey.)

Gelinaria Harveyana J. Agardh.

With the same structure but very densely compoundly pinnate, with narrower segments. These are crowded and fleshily solid, contrasting with the fewer, bolder, broader segments of *G. ulvoidea*.

Western Australia (King George's Sound); South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Victoria.

Family RHODOPHYLLIDACEAE Schmitz.

CONSPECTUS OF SUBFAMILIES.

Cystoclonieae.

Auxiliary cell in a particular protuberance emitting branchlets radiating in all directions.

Rhodophyllideae.

Auxiliary cell evolving numerous bundles of branchlets.

Soliericæ.

Auxiliary cell within the cavity of the fertile nucleus emitting a thick protuberance bearing at the apex numerous bundles of branches.

Subfamily Cystoclonieae (Kützinger) Schmitz.

GLOIOPHYLLIS J. Agardh.

Thallus flat, irregularly forked-laciniate, composed of two strata, the medullary of two layers of very large cells interwoven with thin rhizoids, the cortical of coloured cellules in one or two layers. Cystocarps external, containing within a pericarp of radiating filaments a compound nucleus formed by bundles of spore threads radiating from a central basal placenta. Tetrasporangia immersed in the cortical stratum, zonately divided.

Gloiophyllis Barkeriae (Harvey) J. Agardh.

Frond cuneate at base, expanded upwards, deeply divided, the divisions variously cleft. Cystocarps thickly scattered over the surface of the larger laciniae. Height 20 cm. to 40 cm. Breadth of segments 2 cm. to 5 cm. Colour blood-red.

South Australia (Eastern Bays) and Victoria.

Gloiophyllis Engelhardtii Reinbold.

A richer ramification than in preceding. Cystocarps globose on the margin of the upper segments.

South Australia (Guichen Bay).

Subfamily Rhodophyllideae Schmitz.

RHODOPHYLLIS Kützinger.

Frond flat, membranous, dichotomously or pinnately decompound, mostly margined with leafy or slender processes, composed of two strata, the medullary of large roundish empty cells, mostly in two layers, the cortical of coloured cellules in one or few layers. Cystocarps, marginal and external, containing within a pericarp of radiating filaments, a compound nucleus,

formed of bundles of spore threads radiating from a central basal placenta. Tetrasporangia immersed among the peripheric cells of the marginal processes. Seen from the surface under the microscope the large cells appear each surrounded by a rosette of the small cortical cells, "rosulate-areolate."

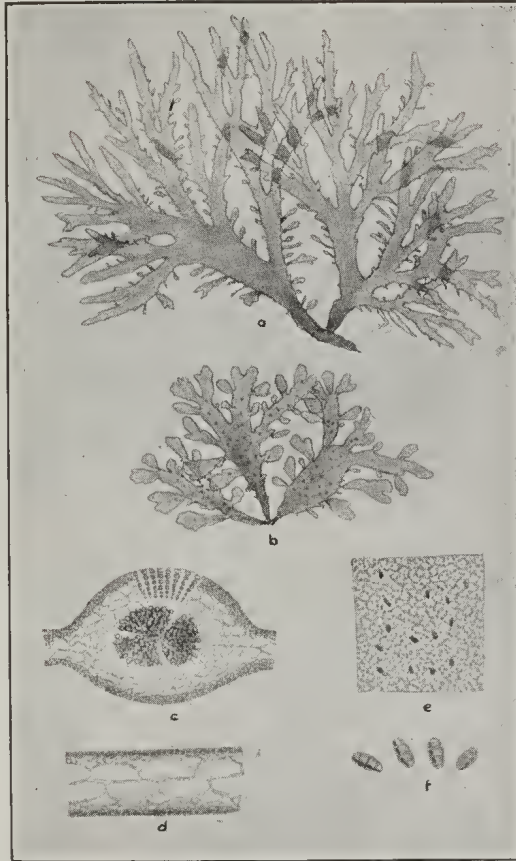


Fig. 37.—*Rhodophyllis volans*: a, plant; b, plant in fruit; c, section through a conceptacle; d, section of the frond; e, portion of the surface of the frond, with scattered tetraspores; f, some tetraspores, removed. (After Harvey.)

A.—Inner cells in two layers, parallel to the surface of the frond. The cortical small cells disposed in a circle round the inner.

a. Fronds without veins.

Rhodophyllis volans Harvey.

Fronds tufted, 5 cm. to 10 cm. long, flabelliform-multipartite, the segments from 6 mm. to 12 mm. broad, cystocarps scattered over the disc of the frond. Tetrasporangia in the pinnae, zonately divided.

Western Australia, South Australia (Investigator Strait, Eastern Bays), Victoria.

- b. Frond traversed by veins or rhizoids.

All fringed by marginal processes or cilia, in which appear the cystocarps and tetrasporangia.

Rhodophyllis blepharicarpa Harvey.

Ten cm. to 14 cm. high. Laciniae 7 mm. to 12 mm. wide, rather rigid. South Australia (Encounter Bay, Eastern Bays).

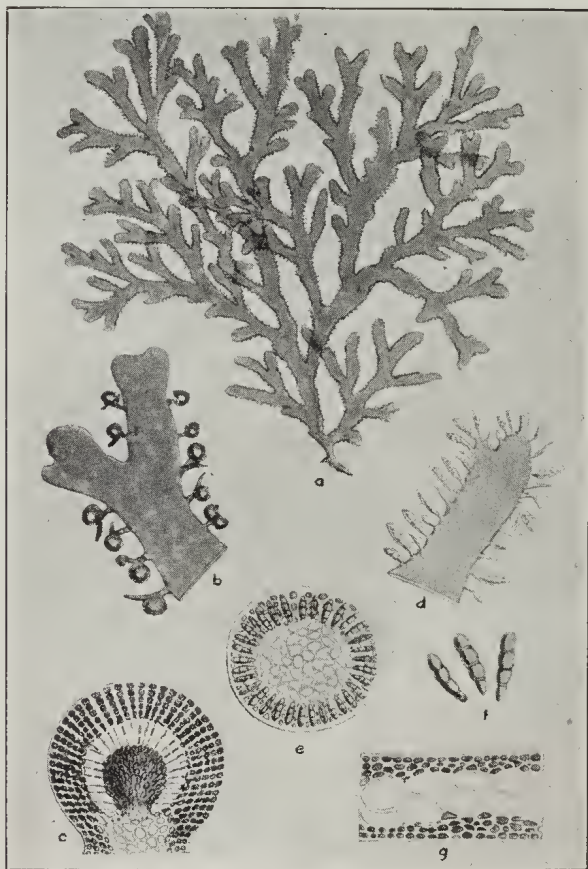


Fig. 38.—*Rhodophyllis blepharicarpa*: a, plant; b, apex of a lacinia, bearing cystocarps; c, section through a cystocarp; d, apex of a lacinia, bearing tetraspores in the marginal processes; e, section of a marginal process, showing the tetraspores *in situ*; f, tetraspores extracted; g, section of the frond. (After Harvey.)

Rhodophyllis ramentacea (Ag.) J. Agardh:

Fifteen cm. to 20 cm. high. Segments 5 mm. to 10 mm. wide. Membranaceous.

South Australia (Eastern Bays).

Rhodophyllis membranacea Harvey.

Five cm. to 6 cm. high. Segments 2 mm. to 5 mm. wide. Thinly membranaceous.

South Australia (Eastern Bays), Tasmania.

B.—Inner cells in two layers parallel to the surface of the frond. Rosulate-areolate. No veins. Segments not fringed.

Rhodophyllis Gunnii Harvey.

Twenty cm. to 30 cm. high. Pinnatifid, segments 2 cm. to 3 cm. wide. Lobes of the pinnules obtuse.

South Australia, Victoria, Tasmania, New Zealand.

Rhodophyllis multipartita Harvey.

Six inches high, segments 2 mm. wide.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania.

C.—Inner cells in two layers parallel to the surface, the cells of the layers alternating. Rosulate-areolate. Segments linear, not fringed.

Rhodophyllis Brookeana J. Agardh.

Seven cm. to 10 cm. high, segments 2 mm. wide.

Western Australia (Israelite Bay), South Australia (Eastern Bays).

D.—Surface rosulate-areolate, the inner cells alternating in two layers parallel to the face of the frond; the whole enclosed by an evident cuticle.

Rhodophyllis Goodwiniae J. Agardh.

At length venous. 25 cm. high, lower segments 2 mm. to 3 mm.

South Australia (Eastern Bays), Victoria, Tasmania.

Rhodophyllis tenuifolia (Harv.) J. Agardh.

Frond below dichotomous, upper segments pinnate and fimbriate at the margins; segments ultimately fimbriate and narrowly acuminate, dentate. Cystocarps immersed in the margin, with a pericarp of radiating cells. Tetrasporangia in upper segments, sparse.

South Australia (Holdfast Bay, Investigator Strait, Eastern Bays), Western Australia.

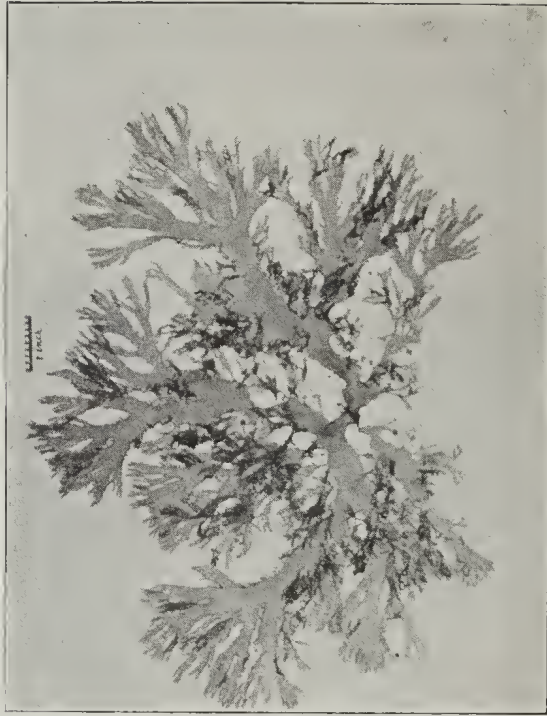


Fig. 39.—*Rhodophyllis membranacea*.



Fig. 40.—*Rhodophyllis Gunnii*—Variants.

Subfamily Solierieae Harvey.
CONSPECTUS OF THE GENERA.

A.—Fronde terete.

1. Frond moniliform-articulate. Central axial syphon *Erythroclonium* Sonder.
2. Frond laxly tubulose, branching in all directions *Rhabdonia* Harvey.
3. Frond succulent, fusiform *Solieria* J. Agardh

B.—Fronde flat, two-edged.

4. Traversed by a central syphon *Areschougia* Harvey.
5. Frond pinnate, branches mostly opposite *Thysanocladia* Endlicher.

ERYTHROCLONIUM Sonder.

Stem terete, its branches constricted as if jointed, composed of an axial filament, surrounded by three strata, the medullary of interwoven longitudinal filaments, the intermediate of several layers of roundish-coloured cells, the cortical of very minute vertically seriate cellules. Cystocarps sessile, depressed, umbilicate, opening by a central pore, containing within a thick pericarp moniliform strings of spores, radiating from a free central placenta. Tetrasporangia dispersed through the cortical stratum, zonately divided.

Erythroclonium angustatum Sonder.

Almost the whole frond constricted articulate, branches verticillate, the joints narrow-linear, attenuate at both extremities. Height 5 cm. to 8 cm. South Australia (Eastern Bays) and Victoria.

Erythroclonium Sonderi Harvey.

Stipes 1 cm. to 3 cm. long, bulbous, breaking suddenly into several branches, 10 cm. to 15 cm. long, sub-trichotomously decompound, ramuli opposite, the joints elliptic-oblong, clavate, thick and obtuse.

Western Australia, South Australia (Eastern Bays), Victoria.

Erythroclonium Muelleri Sonder.

Stem thick, cylindrical, branched; branches opposite or whorled, constricted, ramuli moniliform, the internodes oval or oblong. Height 15 cm.

South Australia (Investigator Strait, Eastern Bays), Victoria, Tasmania.

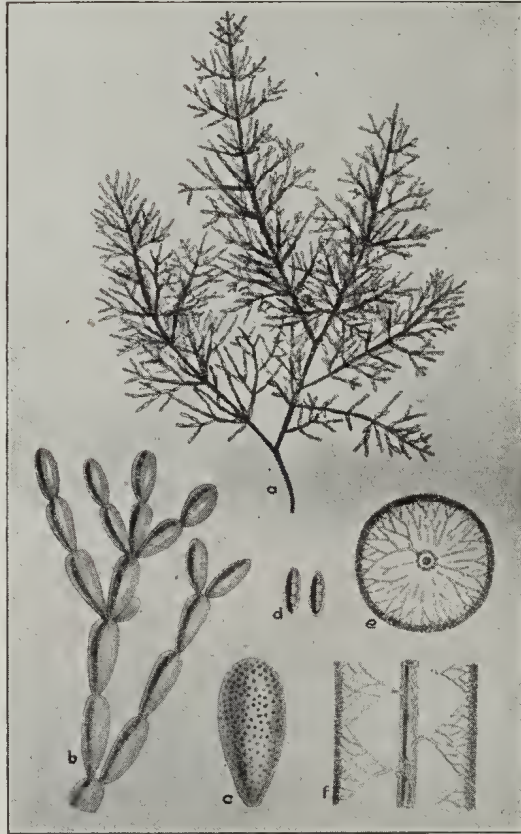


Fig. 41.—*Erythroclonium Muelleri*: *a*, plants; *b*, branchlets; *c*, one of the internodes, with tetraspores; *d*, tetraspores; *e*, cross-section of frond; *f*, longitudinal section. (After Harvey.)

RHABDONIA Harvey.

Frond terete, cylindrical, branched on all sides, or moniliform, constricted into joints, composed of three strata; the medullary a dense bundle of longitudinal filaments; the intermediate a very laxly fibrous stratum; the cortical thick, composed of many layers of small, coloured cellules. Cystocarps immersed in the branches, enclosed in a network of filaments, radiating from a central placenta. Tetrasporangia dispersed through the superficial stratum, zonately divided.

A.—Frond filiform, subcontinuous.

Rhabdonia nigrescens Harvey.

Frond filiform, irregularly very much branched, virgately similarly decompound, ramuli constricted at the base, apices acuminate. Infracortical cells in one layer. Substance rather rigid. Colour dusky-purple. Height 10 cm. to 14 cm.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania.

Rhabdonia coccinea Harvey.

Frond stipitate, dendroid, very much branched and bushy, alternately pinnate decompound, ramuli attenuated at base and apex. Infracortical cells in several layers. Substance cartilaginous and rather soft. Colour when growing is a deep full-red, which becomes a brilliant crimson if the plant is steeped in fresh water. Height 15 cm. to 30 cm., about 1 mm. thick.

Western Australia, South Australia (Investigator Strait, Eastern Bays), Victoria, Tasmania.

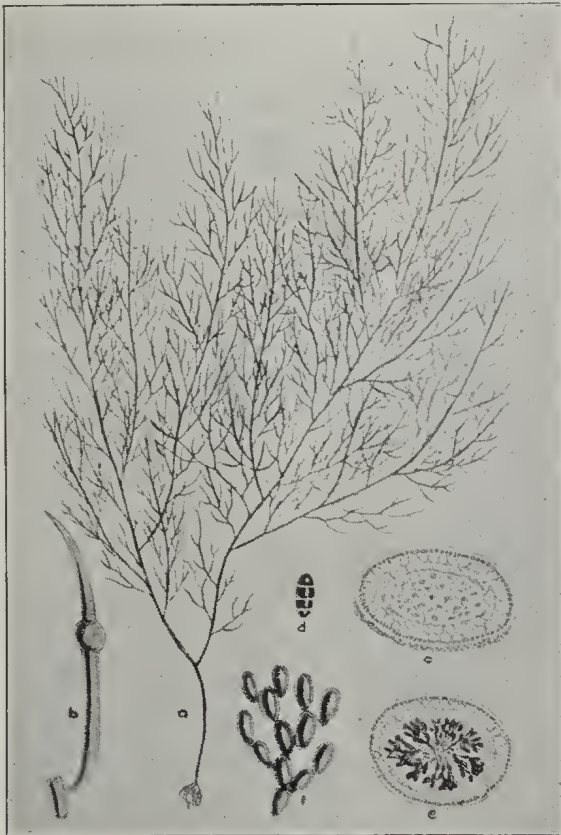


Fig. 42.—*Rhabdonia coccinea*: a, plant; b, ramulus with an imbedded conceptacle; c, cross-section of the frond; d, a tetraspore; e, cross-section of a conceptacle; f, one of the spore threads removed. (After Harvey.)

Rhabdonia dendroides Harvey.

Stem robust, 20 cm. to 25 cm. high, corneo-cartilaginous, rigid-decompound. Upper branches dense, tufted at the extremities. The ramuli taper at the apex but not at the base. Colour dull-red.

Western Australia, Victoria, Tasmania, and South Australia (Encounter Bay, Eastern Bays).

B.—Juvenile frond, and the branches of the adult, sub-articulately constricted, branches arising at the strictures often verticillate.

Rhabdonia charoides Harvey.

Frond flaccid, caespitose, constricted at intervals into pseudo-joints, whorled at the nodes with similarly constricted branches, whorled with ramuli, internodes of stem and branches fusiform, echinulate, 1 cm. to 3 cm. long. Ramuli tapered, often drawn out into tendrils. Height 7 cm. to 14 cm. Substance soft and delicate. Colour rosy-red.

Victoria.

Rhabdonia verticillata Harvey.

Stem short and thick, beset with wart-like abortive ramuli, emitting numerous decompound branches. Branches constricted into pseudo-joints which decrease in length upwards, and whorled at the nodes with similarly

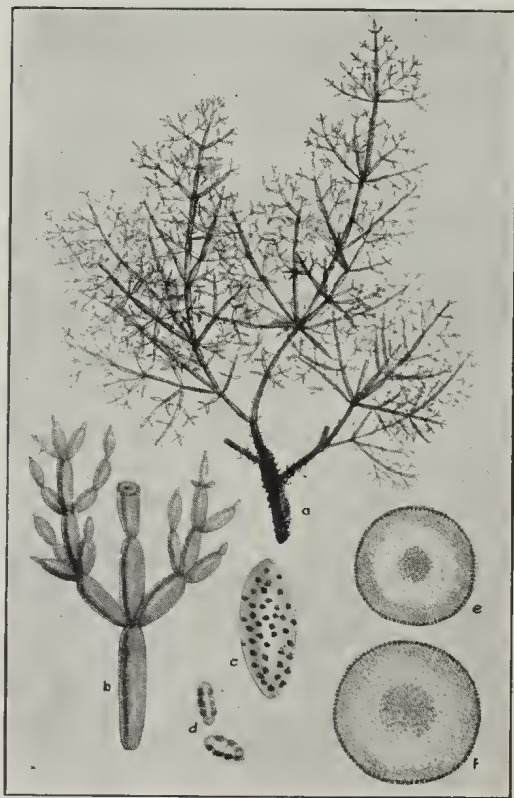


Fig. 43.—*Rhabdonia verticillata*: a, plant; b, branchlets; c, one of the internodes with tetraspores; d, tetraspores; e, cross-section of younger branch; f, cross-section of older branch. (After Harvey.)

constricted and whorled lesser branches. Lower internodes linear oblong, terminal acute. Height 6 cm. to 30 cm. Substance soft and juicy. Colour deep full-red, becoming dark and brownish on drying.

South Australia (Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays), Victoria, Tasmania.

Rhabdonia clavigera J. Agardh.

Fronde almost all tubulose (with longitudinal filaments) and jointed by regular strictures with verticillate branches, above subcorymbose. Lower joints of the stem very long, narrowly obconical, upper oblong or oval. No thickened base of the stem. The plant has the habit of *Erythroclonium Muelleri*. Height 10 cm.

South Australia (Eastern Bays), Victoria.

Solieria J. Agardh.

Very close to *Rhabdonia*, constructed of the same three strata. Cystocarps and tetrasporangia evolved in gelatinous, soft, fusiform ramuli. The tetrasporangia are divided zonately according to Agardh and Harvey, but Kylin says they are cruciately divided. I confess myself baffled by the sporangia of *S. robusta*; they are small and generally not divided at all, and I have been unable to find one definitely cruciate or definitely zonate.



Fig. 44.—*Solieria robusta*.

Solieria robusta (J. Ag.) Kylin.

Frond dendroid, 30 cm. to 60 cm. high, robust, excessively branched, branches alternate or scattered, many times alternately compounded. Diameter 3 mm. to 6 mm. All the segments pointed at both ends, fusiform. The substance fleshy and succulent, soft and flexible. Colour a deep-red. Grows in fairly deep water.

Western Australia, South Australia (Encounter Bay, Investigator Strait), Victoria, Tasmania.

ARESCHOUGIA Harvey.

Frond compressed, distichous or terete, with all-round branching. In the centre runs a prominent monosiphonous articulated axis, from each joint of which emerges a branch on each side. Around this is a medullary stratum, often of great width, consisting of longitudinal, anastomosing interwoven filaments; there may follow an intermediate stratum of roundish coloured cells; and outside is the cortical stratum, well developed, of minute vertically-seriate, coloured cellules. Cystocarps immersed in the medullary stratum, enclosed in a network of filaments, and opening by an external pore, containing moniliform strings of spores, radiating from a central placenta. Tetrasporangia in the cortical stratum of the ramuli, zonately divided. All coriaceous-cartilaginous.

a. Frond terete.

Areschougia Laurencia (Hooker and Harvey) Harvey.

Frond equally filiform, terete, sub-dichotomously branched on all sides, above sub-corymbose, below bare; larger branches erecto-patent, scarcely attenuated; smaller branches narrowly lanceoid, with cystocarps immersed in nodose inflations. Colour dark-purple.

Western Australia, South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Victoria, Tasmania.

Areschougia congesta (Turn.) J. Agardh.

= *A. gracilarioides* Harvey.

Frond caulescent, above gradually tapering, terete, branching on all sides; above subcorymbose, below the smaller ramuli sub-seriate, larger ramuli, erecto-patent at base and scarcely attenuated; ramuli patent, ultimately slightly attenuate on both sides.

South Australia (Eastern Bays), Victoria.

b. Frond two-edged, flat and linear.

Areschougia ligulata Harv.

= *Areschougia australis* Harvey.

Stem terete at base, compressed, flattened and midribbed upwards, laxly much branched, branches ligulate, linear, elongate, distantly denticulate; ramuli constricted at base, sub-obtuse. Height 50 cm. to 90 cm., width fairly

uniform throughout the plant, 2 mm. to 5 mm. Substance coriaceous-cartilaginous. Colour a clear deep-red, fading to yellow and creamy-white.

Western Australia and South Australia (Investigator Strait, Eastern Bays).

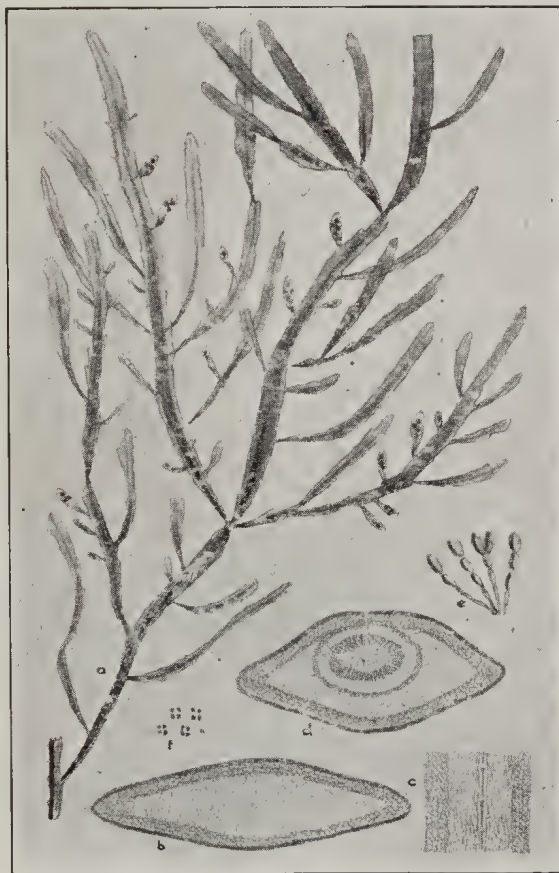


Fig. 45.—*Areschougia ligulata*: *a*, portion of a frond; *b*, cross-section through an old stem; *c*, longitudinal section of same; *d*, cross-section of fertile ramulus, through one of the conceptacles, which is surrounded by a band of pseudo-tetraspores; *e*, strings of spores from the nucleus; *f*, pseudo-tetraspore. (After Harvey.)

THYSANOCLADIA Endlicher.

Frond flat, two-edged, distichously decompound-pinnate, the pinnae opposite, composed of three strata; the medullary of densely interwoven slender, longitudinal filaments, without an articulated central axis; the intermediate of roundish-oblong cells; the cortical of minute, vertically seriated, coloured cellules. Cystocarps semi-immersed, containing within a thick pericarp, minute spores arranged in spore-threads radiating from a large placenta. Tetrasporangia cruciately divided.

Thysanocladia Harveyana J. Agardh.

Frond with terete stipe, above flat and without a midrib, distichously decompound-pinnate; pinnae broadly linear, patent, sub-opposite; pinnules

patent, broadly linear, flat, simple or pinnulate; axils of pinnae rounded. Sori of tetrasporangia in the dilated apices of the ramuli. Height 30 cm. 2 mm. to 6 mm. wide. Substance coriaceous, firm and tough. Colour a somewhat livid-purple.

Western Australia, South Australia (Encounter Bay, Eastern Bays).

Thysanocladia laxa Sonder.

Greatly resembling the preceding, but with a conspicuous thin midrib in the pinnae. The laciniae often trieuspid.

South Australia, Victoria, New South Wales.

Thysanocladia oppositifolia (Ag.) J. Agardh.

Holdfast a large disc nearly 2 cm. across. Stems usually dividing near the base into several long, simple, virgate secondary stems, each 10 cm. to 40 cm. high, mostly denuded below, but for the greater part of their length closely feathered with opposite decompound pinnae. The segments narrow, subulate. The pinnae rigid and very closely opposed, often overlapping. Colour a very dark brownish-red, even blackening on drying.

Western Australia and South Australia (Fowler's Bay, Rivoli Bay, and Investigator Strait).

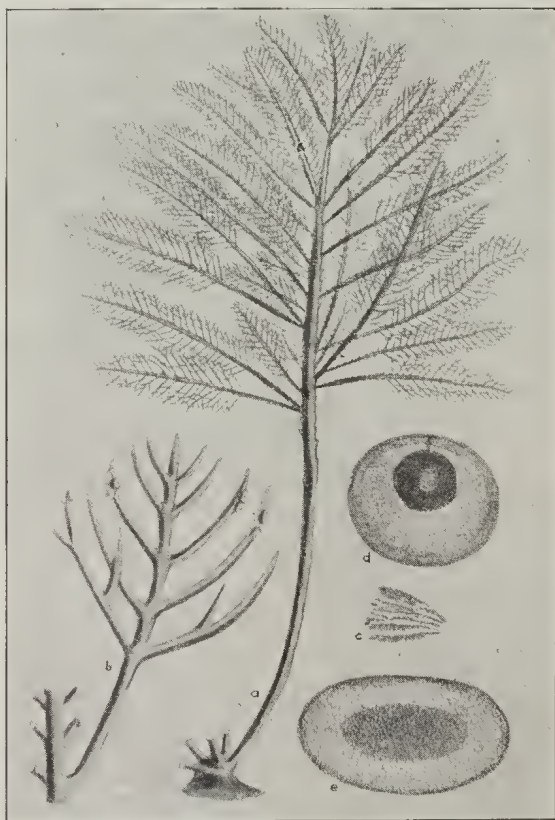


Fig. 46.—*Thysanocladia oppositifolia*: a, plant; b, a pinnated ramulus (plumule); c, cross-section of the frond; d, cross-section of fertile ramulus and conceptacle; e, spore strings. (After Harvey.)

Order **RHODYMENINAE.**

CONSPECTUS OF FAMILIES.

I.—Gonimoblast immersed in the thallus, adnate in the cavity of the cystocarp to a thickened placenta which radiates into the cavity; the thickened pericarp perforated at the apex.

Sphaerococcaceae.

Gonimoblast hemispherical-convex, much branched, compact and confluent; carpospores single or in chains on the apices of the branchlets. Tetrasporangia cruciately or zonately divided.

Rhodymeniaceae.

Gonimoblast divided into several successive lobes; carpospores evolved from almost all the cells of the lobes. Tetrasporangia almost always cruciately divided.

II.—Gonimoblast sessile in the thallus, evolved within a cavity convexly elevated and covered by the cortex of the thallus perforated at the apex.

Delesseriaceae.

Procargs disposed in the middle stratum of the thallus. Gonimoblast adnate to a thickened placenta, lobes usually indistinctly evolved; carpospores single or seriate at the apices of fertile branches. Tetrasporangia triangularly divided.

Bonnemaisoniaceae.

Procargs disposed in the cortex of the thallus. Gonimoblast adnate to a wide base, forming a much branched caespitulum; carpospores formed from the terminal cells of the fertile branchlets. Tetrasporangia cruciately, triangularly, or more or less irregularly zonately divided.

III.—Gonimoblast affixed to the thallus by a pedicel or a broad base, *i.e.*, altogether external or only included by the cortex in a varying way.

Rhodomelaceae.

Cystocarps attached to the thallus by a short pedicel or broad base. Gonimoblast evolved within the cavity open at the apex; carpospores single, or rarely in chains, on the apices of the fertile branches. Tetrasporangia triangularly divided.

Ceramiaceae.

Cystocarps altogether external, or included in the cortex, naked or involucreted loosely by special ramuli. Gonimoblasts single or more often twin, mostly divided into several gonimolobes; carpospores formed from almost all cells of the fruitful caespitulum. Tetrasporangia triangularly, or less frequently cruciately divided.

Family SPHAEROCOCCACEAE (Dumont) Schmitz.
CONSPECTUS OF THE SUBFAMILIES.

A.—Cystocarps evolved in special ramuli.

a. Cystocarps borne on summit of a short ramulus.

Tetrasporangia zonately divided *Phacelocarpeae*
(J. Ag.) Schmitz.

b. Cystocarps evolved in special wart-like ramuli.

Tetrasporangia cruciately divided *Stenocladieae*
Schmitz.

B.—Cystocarps not evolved in special ramuli.

c. Carpospore-bearing filaments of several coalescing bundles of branches.

1. Bundles of filaments dense, of equal
height *Melanthalieae*
J. Agardh.

2. Bundles of filaments lax, of unequal
height *Gracilarieae*
(Naeg.) J. Agardh.

d. Cavity of cystocarp traversed by a loose network. Tetrasporangia zonately divided . . .

Hypneae
(J. Agardh) Harvey.

Subfamily Phacelocarpeae (J. Agardh) Schmitz.

PHACELOCARPUS Endlicher and Dietrich.

Frond compressed, alternately decompound pinnate, distichously pinnate (in Australian forms), composed of three strata surrounding a central axial articulated syphon; the medullary of longitudinal, densely interwoven filaments; the intermediate layer of roundish cells; the cortical of minute, coloured, vertically seriate cellules. Cystocarps pedicellate, between the teeth, round- or kidney-shaped, the upper part thickened, with a pore or slit. Nemathecia (packets of tetrasporangia) round- or egg-shaped, containing numerous cavities excavated under the surface-coating and bearing on their walls attached, linear or clavate, zonately divided tetrasporangia, not unlike the strings of spores of a coralline. With the spores are parenemata.

A.—The aeulei or teeth have a broad wing which margins the midrib of the rachis, the length of the teeth being about equal to the width of the rachis.

Phacelocarpus complanatus Harvey.

Frond with an immersed midrib and broadly subulate, flat, slightly incurved, alternately placed teeth, the length of the teeth equalling the width of the rachis. Cystocarps and nemathecium rounded, sessile below the apex of the tooth. Substance tough. Colour dark-purplish. Height 15 cm. to 30 cm.

South Australia (Eastern Bays), Victoria, Tasmania.

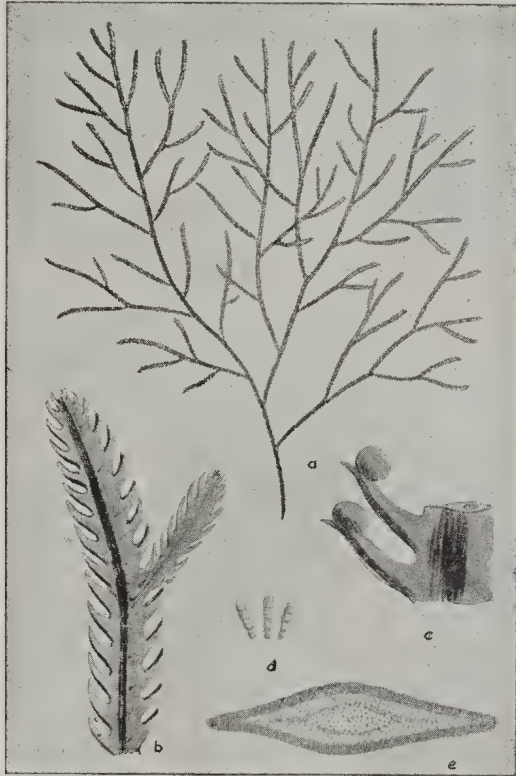


Fig. 47.—*Phacelocarpus complanatus*: a, branch; b, apex of branch; c, two fertile lacinulae, bearing nemathecium; d, tetraspores; e, cross-section of stem. (After Harvey.)

Phacelocarpus alatus Harvey.

Frond distichously pectino-pinnate; a narrow wing marginating the broad midrib, the length of the acuminate teeth about equalling the width of the rachis. Warty cystocarps and rounded nemathecium terminal on a tooth transformed into a pedicel. Thirty cm. high. Colour deep-red.

Western Australia, South Australia (Encounter Bay, Eastern Bays), Victoria.

B.—The teeth with a very narrow wing marginating the midrib, the length of the teeth greater than the width of the rachis.

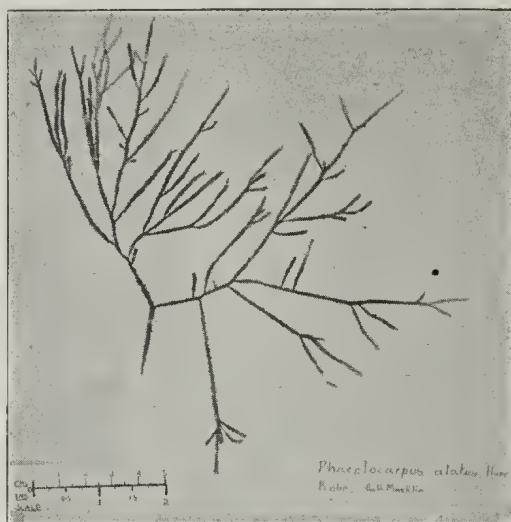


Fig. 48.—*Phacelocarpus alatus*.

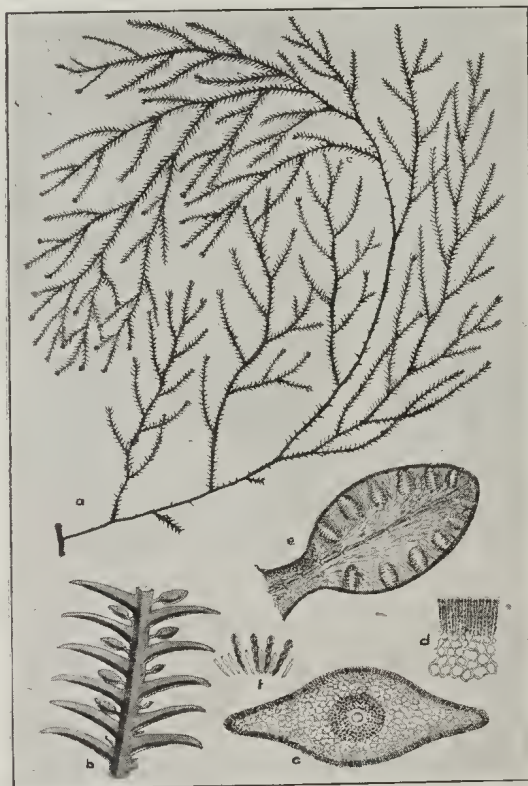


Fig. 49.—*Phacelocarpus Labillardieri*: a, branch of plant; b, portion of branch in fruit; c, cross-section of stem; d, small fragment of periphery of same; e, longitudinal section through a receptacle, showing many tetraspore cavities; f, tetraspores and paranemata from the same. (After Harvey.)

Phacelocarpus Labillardieri (Mertens) J. Agardh.

Frond irregularly, alternately compound, pinnate much branched, 20 cm. to 90 cm. high, 2 mm. to 3 mm. in diameter. Teeth subulate, twice as long as the breadth of the rachis. Cystocarps reniform, transversely below the apex of a tooth. Nemathecia clavate, pedicellate. Colour deep-red. The commonest species.

All round temperate Australia, Tasmania, and New Zealand. Collected in South Australia from Encounter Bay, Investigator Strait, Eastern Bays.

Phacelocarpus sessilis Harvey.

Almost no margining wing. Length of teeth exceeding width of rachis. Nemathecia clavate-globose, with very short pedicel. Cystocarps not seen.

South Australia (Eastern Bays) and Victoria.

Subfamily Stenocladieae Schmitz.

STENOCLADIA J. Agardh.

Frond compressed and distichously pinnate or terete and vaguely branched. A central axial syphon, articulated, each joint sending out four lateral branches; a medullary stratum of elongated articulated threads densely interwoven; an intermediate, sometimes wanting, of oblong cells loosely disposed; a cortical of smaller, vertically seriate coloured cells. Cystocarps external, spherical, sessile on the sides of the branches, within a cellular pericarp, opening by a carpostomium. Tetrasporangia in pod-like swollen branches, cruciately divided.

Stenocladia furcata (Harvey) J. Agardh.

Frond terete, decompound dichotomous, fastigiate, the divisions with rounded axils and acute apices. Height 10 cm. to 15 cm. or more, 1 mm. to 2 mm. diameter. Substance firmly cartilaginous. Colour dark-red.

South Australia and Victoria.

Stenocladia Harveyana J. Agardh.

Frond compressed above, inconspicuously midribbed, pinnately decompound. Height 10 cm. to 15 cm. Diameter 2 mm. Firmly cartilaginous. Dark-red.

Western Australia, South Australia, Victoria.

Stenocladia ramulosa J. Agardh.

= *Areschougia dumosa* Harvey.

Frond dendroid, bushy. Branches slender, dichotomo-multifid. Height 5 cm. to 8 cm., diameter of stem 1 mm. Substance rigid and wiry. Colour very dark red-brown, going black on drying.

South Australia (Eastern Bays) and Victoria.

NIZYMENIA Sonder.

Frond horny-membranous, flat, linear or strap-shaped, decompound, branches distichous, above more regularly, oppositely pinnate, composed of three strata, the medullary of densely woven, anastomosing filaments, the intermediate of roundish-angular cells, the cortical of minute coloured cells. No central tube. Cystocarps sessile, thick-walled, wrinkled, containing minute sub-seriated spores, radiating from a central, basal fibro-cellular placenta. Tetrasporangia not known.

Nizymenia australis Sonder.

Fronds 15 cm. to 30 cm. high, 3 mm. to 6 mm. wide. Main branches much constricted at the insertion. Segments obtuse. Colour blood-red.

South Australia (Eastern Bays), Victoria, Tasmania.

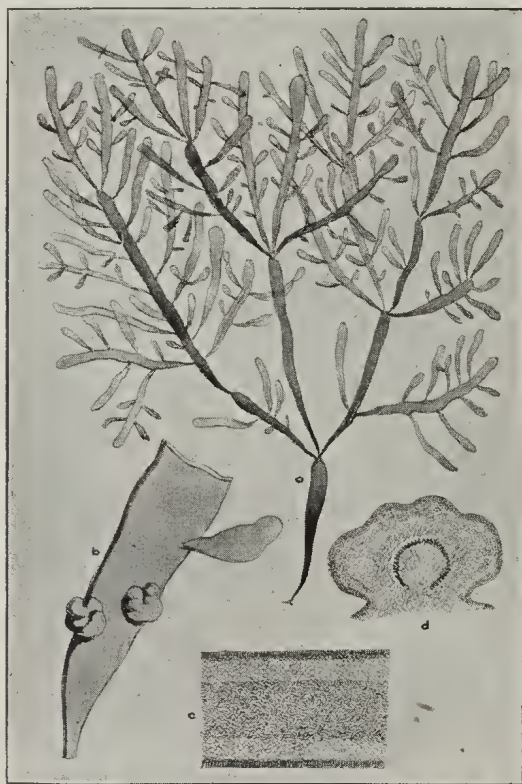


Fig. 50.—*Nizymenia australis*: a, plant; b, part of small branch, with conceptacles; c, transverse section of the frond; d, vertical section of a conceptacle. (After Harvey.)

Subfamily Melanthaleae J. Agardh.

MELANTHALIA Montagne.

Frond linear, plano-compressed, dichotomous and fastigate, solid, coriaceous, densely cellular, of two strata, the medullary of elongate angular colourless cells, the outer ones shorter; the cortical of very minute, coloured, vertically seriated cellules. Cystocarps marginal, hemispherical, thick-walled, bearing, on a basal placenta, densely tufted moniliform spore-threads, at length separating into minute spores. Tetrasporangia evolved in thickened, sub-club-shaped apices of branches (nemathecia), cruciately (?) divided.

Melanthalia obtusata (Labillardière) J. Agardh.

Frond elongate, 10 cm. to 60 cm. long, repeatedly dichotomous and flabelliform; segments 2 mm. to 4 mm. wide, linear, two-edged, bluntly truncate. Substance very tough, leathery. Colour brownish-purple, tending to black. Growing on rocks a little below low water.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Victoria, Tasmania.



Fig. 51.—*Melanthalia obtusata*: a, plant; b, branch of var. *intermedia*; c, horizontal section of a conceptacle and portion of the branch; d, some spore-threads from the nucleus. (After Harvey.)

Melanthalia concinna (R. Brown) J. Agardh.

Frond filiform, little compressed; height 10 cm., width 1 mm. Colour reddish.

South Australia (Encounter Bay, Eastern Bays) and Victoria.



Fig. 52.—*Melanthalia concinna*.

Curdiea Harvey.

Frond flat, coriaceous-cartilaginous, with broad and narrow laciniae, composed of two strata, the medullary of roundish-angular cells, the cortical of very minute, sub-vertically seriated coloured cellules. Cystocarps marginal, globose, sessile, containing, within a very thick pericarp, minute spores arranged in spore-threads issuing from a large fleshy placenta. Tetrasporangia in superficial intramarginal warts (nemathecia), cruciately divided.

Curdiea laciniata Harvey.

Frond 30 cm. to 60 cm. high, thick, fleshy-coriaceous, divided very irregularly into broad and narrow ribbon-like laciniae; from $\frac{1}{2}$ cm. to $2\frac{1}{2}$ cm. in width, parallel or palmatifid; the apices blunt or jagged. Cystocarps conspicuous, about 1 mm. across. Colour red or liver-coloured.

South Australia (Encounter Bay, Eastern Bays), and Victoria, common; rare in Tasmania.

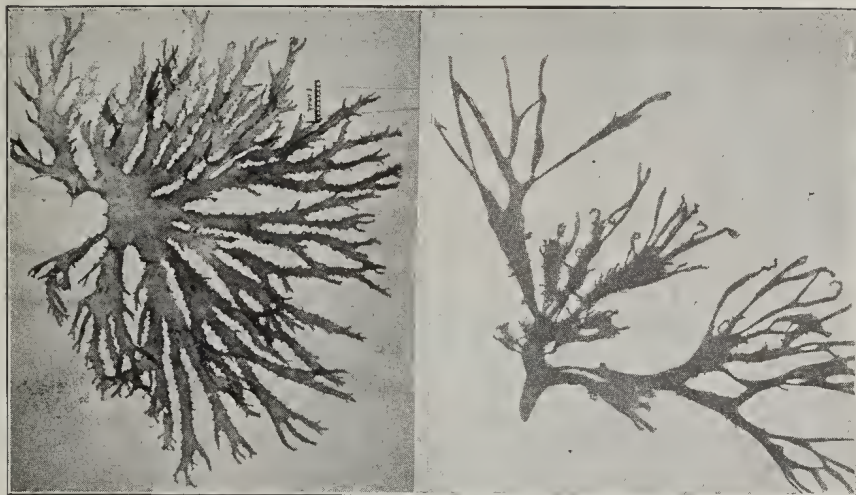


Fig. 53.—*Curdiea laciniata*; (Left) with marginal cystocarps.



Fig. 54.—*Curdiea laciniata*: a, portion of a frond, with marginal coccidia; b, a fragment, with nemathecia; c, section of the frond and of a nemathecium; d, a tetraspore and paranemata; e, section of a coccidium. (After Harvey.)

Curdiea Engelhardtii J. Agardh.

Frond a foot or more high, decompound pinnate, emitting branches, large and small distichously from the margin; rachides and pinnae contracted at the base, then flat and linear, coriaceous, prone to divide at the apex. Up to 3 cm. in greatest width. Cystocarps on the flat surface, of the *Curdiea* structure.

South Australia (Lacepede Bay).

Subfamily Gracilarieae (Naegeli) J. Agardh.

1. Frond terete or flat. Tetrasporangia cruciately divided *Gracilaria*
Greville.
2. Frond flat. Tetrasporangia zonately divided *Tylopus*
J. Agardh.

GRACILARIA Greville.

Frond filiform, cartilaginous, irregularly branched, composed of two strata; the medullary of large, rounded cells, smaller outwards, usually containing granules; the cortical of minute cellules, vertically seriate, or in a single row. Cystocarps hemispherical or conical, sessile on the branches, containing within a thick pericarp obovate spores arranged in spore-threads issuing from a basal placenta. Tetrasporangia, not in nemathecia, scattered among the surface cellules of the branches and ramuli.

A.—The inner medullary cells conspicuously greater than those next outside to them. Cortical cells sub-monochromatic.

Gracilaria confervoides (L.) Greville.

Fronds elongate, like fine twine, flabelliform; branches elongate, subdivided. Cystocarps numerous on the branches, hemispherical. Tetrasporangia numerous in a thickened filiform branch. Height to one meter. Colour purplish.

Widely distributed in the Atlantic, West Indies, Cape of Good Hope, the Philippines, and in Australia and Tasmania. In South Australia, collected from Encounter Bay.

B.—The inner medullary cells fairly large, decreasing in size gradually outwards. The cortical cells disposed in several series.

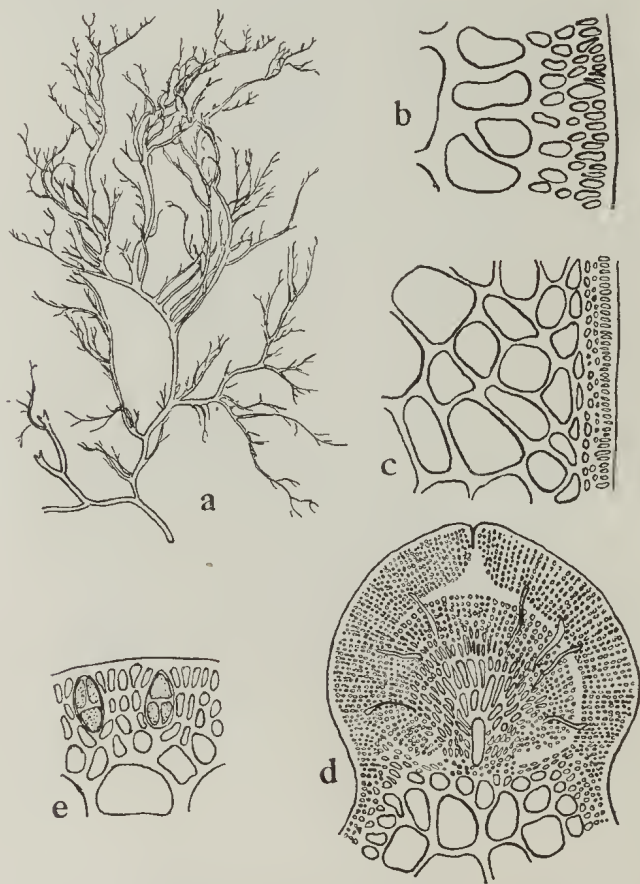


Fig. 56.—*Gracilaria confervoides*: a, habit of a plant; b and c, transverse and longitudinal sections of thallus; d, section through cystocarp; e, sporangia. (After Taylor and Tilden.)

Gracilaria Harveyana J. Agardh.

Fronds 30 cm. long or more, about 2 mm. thick. Substance solid, fleshy-cartilaginous. Cystocarps minute, scattered over the branches. Colour intensely purple.

Western Australia and South Australia (Holdfast Bay, Eastern Bays).

TYLOTUS J. Agardh.

Frond flat, membranaceous-leathery, di-trichotomous, of two strata, the medullary of rounded-angular cells, externally smaller, the cortical of minute cellules joined in vertical threads. Cystocarps sessile, emerging from the face of the frond, in a very thick pericarp, containing minute spores arranged in spore-threads issuing from a large fleshy central placenta. Tetrasporangia in oblong nemathecium on the middle of a segment, with zonately divided sporangia and parenemata.

Tylotus obtusatus (Sonder) J. Agardh.

Frond brownish-red, membranaceo-coriaceous, irregularly dichotomous, multipartite; axils and apices rounded. Cystocarps scattered over the disc. Tetrasporangia in oval nemathecium, prominent on both surfaces of the frond, seriated along the larger segments. Height 10 cm. to 15 cm.

Western Australia, South Australia (Eastern Bays), Victoria.

Subfamily Hypneae (J. Agardh) Harvey.

HYPNEA Lamouroux.

Frond terete, irregularly much branched, composed of three strata, the medullary of a few slender longitudinal filaments; the intermediate of oblong, angular, hyaline cells; the cortical of one or more layers of minute coloured cellules. Cystocarps hemispherical, containing within a thickish pericarp several clusters of pedicellate spores, affixed to slender anastomosing filaments. Tetrasporangia lodged in swollen branches, zonately divided.

A.—The older ramuli constricted at the base.

Hypnea musciformis (Wulf) Lamouroux.

Caespitose, virgately branched, branches filiform, thickened often below the apex and eireinately incurved, the ramuli patent divaricate, attenuated at both extremities. To 15 cm. or more high. In Australia the commoner form, var. *Esperi*, is sub-cartilaginous and coral-red.

Widely distributed—Mediterranean, West Indies. Western Australia and South Australia (Eastern Bays).



Fig. 57.—*Hypnea musciformis*: Habit of plant, showing hooked branch tips. (After Taylor.)

Hypnea episcopalis Hooker and Harvey.

Holdfast branching, frond terete, elongate, much branched, branches attenuate, subsimple, densely set with small secondary branches, and erect subulate ramuli; stem and main branches bearing several long tendril-like branchlets, naked above and thickened and hooked at the extremities.

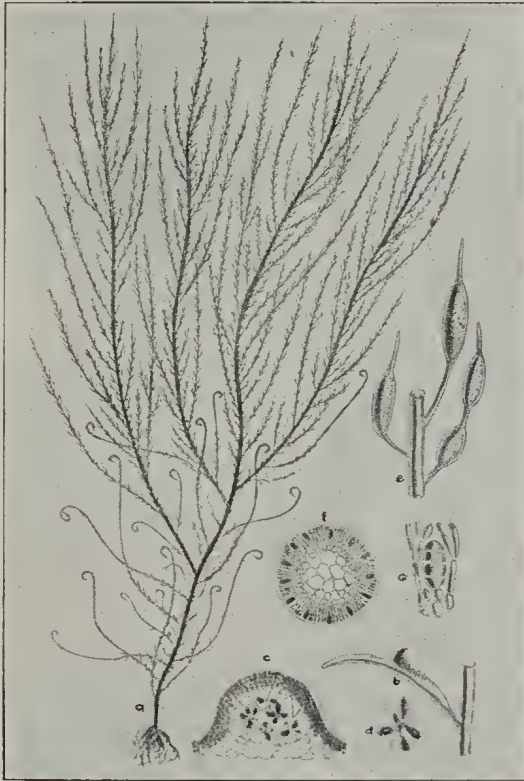


Fig. 58.—*Hypnea episcopalis*: a, plant; b, a ramulus, bearing a conceptacle; c, vertical section of a conceptacle; d, a spore cluster from the same; e, ramuli, with swellings in which tetraspores are imbedded; f, cross-section of the swelling; g, tetraspore and surrounding cells from the same. (After Harvey.)

Cystocarps small, sessile on the upper face of fusiform, simple, patent ramuli. Tetrasporangia in pod-like, pedicellate and mucronate, thickened ramuli. Height 15 cm. to 40 cm. or more, 1 mm. to 2 mm. thick. Substance soft though cartilaginous. Colour deep-red, becoming scarlet in fresh water.

The whole South Coast of Australia, Tasmania. Collected in South Australia from Encounter Bay, Investigator Strait, Eastern Bays. .

B.—Ramuli wider at the base, acuminate.

Hypnea seticulosa J. Agardh.

Frond intricate-bushy, branches not much projecting from the bunch, through their whole length bearing spinules, each with a broader base narrowed above into a sharp bristle. Height about 15 cm., below about 2 mm. thick. Substance sub-corneous (the whole plant rather like a sponge). Colour dull-red.

The South Coast of Australia, Tasmania, Japan. Collected in South Australia from Encounter Bay, Investigator Strait, Eastern Bays.

Hypnea hamulosa (Turn.) Montagne.

Apparently very like *H. seticulosa*, but smaller, 5 cm. to 8 cm. tall and with more marked spines.

Cape of Good Hope, Red Sea, South Australia (Investigator Strait).

GLOIODERMA J. Agardh.

= *Horea* Harvey.

Frond elastic gelatinous, composed of three strata of cells, the central of rounded-oblong cells loosely conjoined, the intermediate of smaller cells or anastomosing threads, the cortical of vertical moniliform threads included in mucus. Cystocarps on papillae, with an angulate-horned pericarp. Tetrasporangia immersed in the cortical stratum, scattered, cruciately divided.

The genus is confined to Australia, Tasmania; three of the five species are already known from South Australia.

A.—Cystocarps scattered over face and along margins of the frond.

Gloioderma australis J. Agardh.

To 15 cm. high, 4 mm. to 8 mm. wide. Named *Horea polycarpa* by Harvey from the numerous cystocarps scattered over the frond.

South Australia (Eastern Bays), Victoria, Tasmania.

B.—Cystocarps marginal or sub-marginal.

a. Frond filiform, less compressed, narrow, 2 mm. to 3.5 mm. wide.

Gloioderma fruticulosum (Harv.) De Toni.

Victoria and Tasmania.

b. Frond compressed, flat, broader.

Gloioderma Wilsonis (J. Ag.) De Toni.

Fronds erect, segments straight, almost fastigiata, to 14 mm. wide.

Victoria and Tasmania.

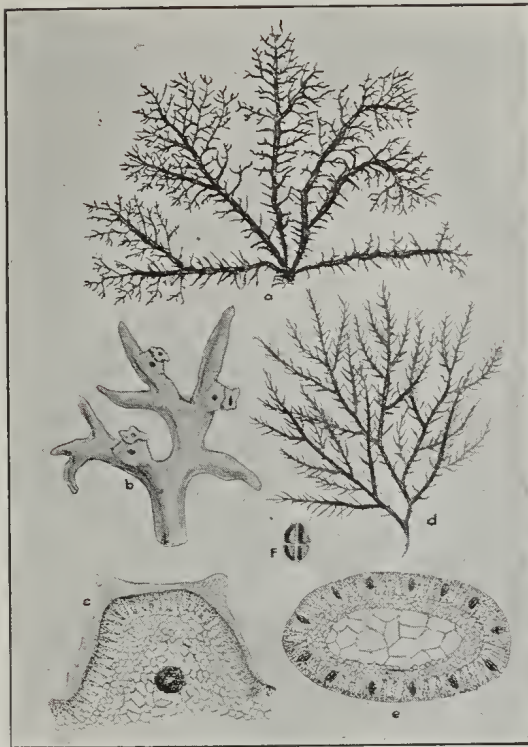


Fig. 59.—*Gloioderma fruticosum*: a, conceptacle bearing plant; b, ramulus, with conceptacles; c, vertical section of a conceptacle; d, tetraspore bearing plant; e, cross-section of a ramulus, with tetraspores *in situ*. (After Harvey.)



Fig. 60.—*Gloioderma Wilsoni*.

Gloioderma halymenioides (Harvey) De Toni.

Frond dichotomous, the segments decompound, pinnate, pinnules and pinnae slender, divaricate, sometimes inosculating. To 8 mm. wide.

Western Australia and South Australia (Investigator Strait).

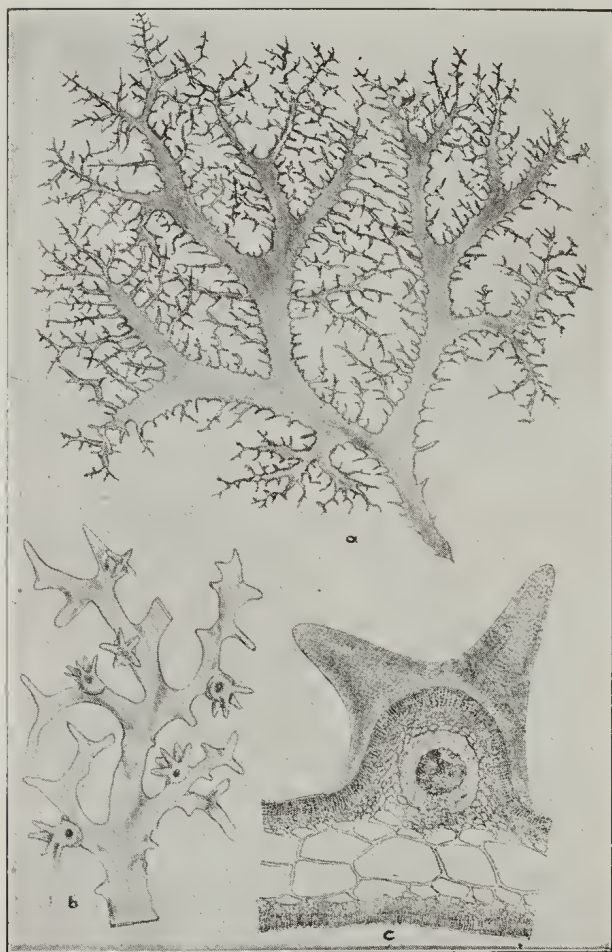


Fig. 61.—*Gloioderma halymenioides*: a, plant; b, part of a fertile frond; c, section through a pericarp and portion of the frond. (After Harvey.)

Gloioderma tasmanica Zan. (= *Horea speciosa* Harvey.)

Frond flat, distichously pinnate, apices of the lower pinnules often hooked. To 6 mm. wide.

South Australia (Investigator Strait, Eastern Bays), Victoria, Tasmania.

The colour of this species is often bright-red. It grows in water five or more fathoms deep, and is best secured by dredging.

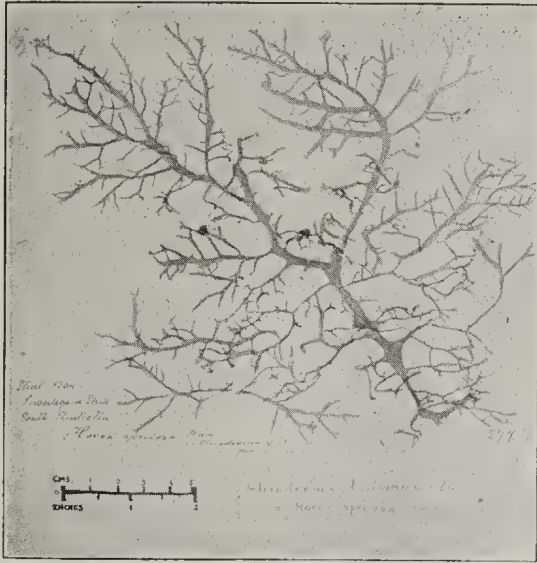


Fig. 62.—*Gloioderma tasmanica*.

FAMILY RHODYMENIACEÆ.

Subfamily Rhodymenieae (J. Agardh) Schmitz.

Fronde terete or flat, erect. Cellular or filamentose-cellular structure. Cavity of the cystocarp containing only the residue of a restricted plexus. Gonimoblast lobes closely confluent. Placenta often minute.

CONSPECTUS OF THE GENERA.

A.—Frond solid.

- a. Tetrasporangia triangularly divided *Hymenocladia*
J. Agardh.
- b. Tetrasporangia zonately divided *Stictosporum*
(Harv.) Schmitz.
- c. Tetrasporangia cruciately divided, frond flattened.
1. Cystocarps scattered over the surface of
the frond. Structure cellular *Rhodymenia*.
Greville.
2. Cystocarps evolved in leaves proliferating
from the surface of the frond *Epymenia*
Kützinger.
3. Cystocarps scattered over the surface of the
frond. Structure cellular-filamentous *Sebdenia* Berth.

B.—Frond hollowed or tubular.

a. Tetrasporangia cruciately divided.

1. Frond sac-like *Gloiosaccion*
Harvey.

2. Frond cylindrical hollow, with similar
lateral proliferations *Bindera* Harvey.

b. Tetrasporangia triangularly divided.

1. Frond tubular, divided by transverse parti-
tions; pericarp osteolate *Champia* Desvaux.

2. Frond tubular, constricted at nodes, peri-
carp without an osteole *Chylocladia*
Greville.

3. Frond consisting of enlarged rounded
hollow inflations connected necklace-wise
by narrow solid isthmuses *Erythrocolon*
J. Agardh.

HYMENOCCLADIA J. Agardh.

Frond gelatinous-membranaceous, flattened, distichously subdichotomous or pinnately divided, composed of cells in two strata, the inner or medullary of large rounded-oblong cells mingled loosely with smaller cells, the outer or cortical of extremely minute coloured cells arranged in moniliform threads at right angles to the surface. Cystocarps scattered over the frond, hemispherical, with a thick pericarp, and basal placenta and many small carpospores. Tetrasporangia rather large, triangularly divided (into tetrads).

A genus mostly Australian with one other species each in New Zealand and South Africa. There are 10 Australian species. Of these five have already been recorded from South Australia.

Section A.

Species with terete or narrow compressed frond, dichotomous or with sub-pinnate branching from the margin. Cystocarps marginal.

a. Main axis flattened, 5 mm. to 6 mm. wide.

1. Lax, dichotomous, with wide angles and
incurved branches, ultimate branches often
secund *H. dactyloides*.
Sond.

South Australia (Fowler Bay).

2. Branches distichous, pinnate, closely placed,
very patent, long (to 25 cm.), tapering with
acute apices *H. gracilarioides*
J. Ag.

b. Main axis mostly terete, 1 mm. wide.

1. Branches patent, filiform, distantly dichoto-
mous, ramuli divaricate and flexuose *H. filiformis*
Champion Bay, Eucla. J. Ag.

Kylin after a study of the type specimens of both, concludes that *H. subulosa* J. Ag. is not separable from *H. filiformis*.

2. Very decompound, sub-corymbose, pinnate below, dichotomous above, terete but not filiform; the ultimate ramuli secund, acuminate, like deer horns *H. ceratoclada*
 South Australia (Encounter Bay), Victoria. J. Ag.

Section B.

Frond compressed flat, pinnately decompound. Cystocarps scattered over and projecting from the plane face of the frond.

1. Frond dichotomo-pinnate, rachis and branches broadly linear, narrowed at base. Rachis to 12 mm. but usually 6 mm. to 8 mm. Branches ligulate, closely pectinated with patent, simple or pinnulate ramuli *H. usnea* (R. Br.)
 J. Ag.

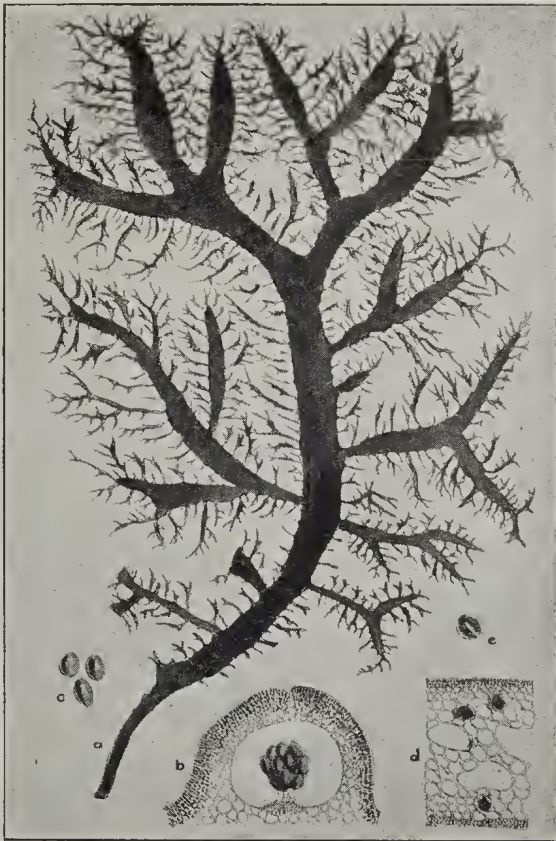


Fig. 63.—*Hymenocladia usnea*: a, plant; b, section of a conceptacle; c, spores from the same; d, cross-section of a frond, with imbedded tetraspores; e, a tetraspore. (After Harvey.)

All round the South Australian coast (Encounter Bay, Investigator Strait, Eastern Bays), Victoria.

Both J. Agardh and De Toni consider *H. ramalina* (Harv.) J. Ag. as a reduced form of *H. usnea*.

2. Frond decom-pound-pinnate, rachis flexuose, narrowed at base and apex, in the middle to 4 mm. wide; pinnae and pinnulae linear-lanceolate, patent; the ultimate ramuli minute, patent setaceous, close-set *H. divaricata* (R. Br.) Harv.

South Australia (St. Vincent Gulf, Investigator Strait, Eastern Bays).

Section C.

Frond broad, flat, dichotomous, or bearing segments from the margins.

1. Stipe short, very soon expanding into the base of the frond; frond dull-red or purplish, very broad (to 60 cm. long and 5 cm. to 8 cm. wide), oblong or ovate, polymorphous, simple with a margin leaf-bearing or cleft into numerous lanceolate segments resembling the main frond in a smaller way; discs smooth with scattered cystocarps *H. polymorpha* (Harv.) J. Ag.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania, in deeper water.

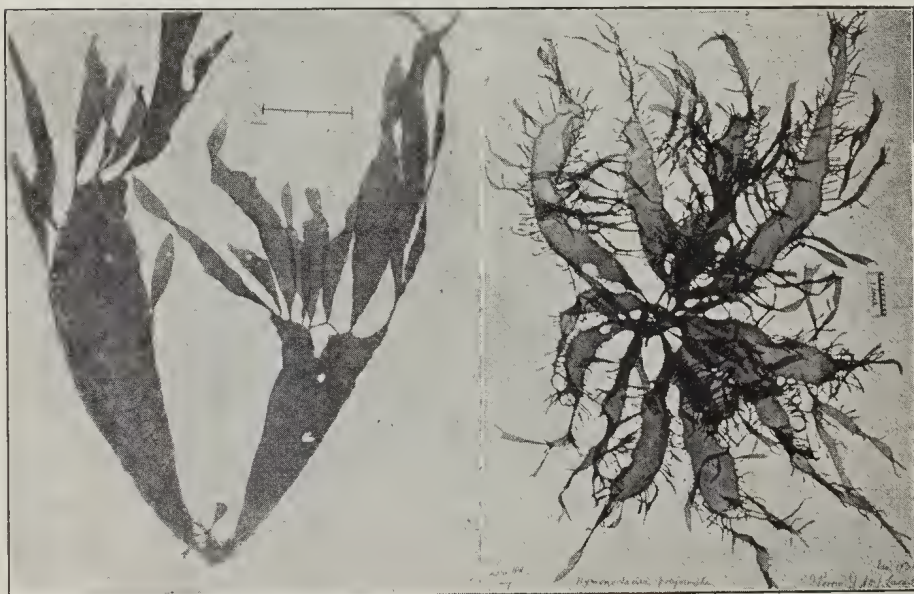


Fig. 64.—*Hymenocladia polymorpha*: Showing variations in form.

2. Stipes short ($1\frac{1}{2}$ cm.) passing rather abruptly into the frond; frond cartilaginous, dark blood-red, simple or sparingly dichotomous, 15 cm. to 20 cm. long to 3 cm. wide, pinnated from the margin; pinnae variously cleft and fimbriate, sometimes multifid, oculo-dentate or ciliate at the margin; discs sprinkled with spinous points or lobules and with cystocarps. When juvenile the frond consists of a simple stalked, smooth circular disc *H. conspersa*
(Harv.) J. Ag.

Western Australia and Victoria, hence probably to be found in South Australia.

In both species the cross-section shows unmingled large cells in the medullary stratum. Hence Harvey attributed them to *Rhodymenia* and *Calliblepharis* respectively.

STICTOSPORUM Harvey.

A genus resembling *Rhodophyllis* in facies and the presence of zonate tetraspores, but differing in the structure of the frond. Inner and cortical cells are of the same moderate size, the cortical coloured, monostromatic, and the medullary sparingly mingled with longitudinal threads. The cystocarps have not been seen. Tetrasporangia are large, more or less immersed in the cortical stratum, scattered and visible on the surface under a low power lens.

Stictosporum nitophylloides Han.

Fronds 15 cm. to 20 cm. high, and as much in the spread, from the base divided into many irregularly dichotomous or multifid spreading lacizeae, all the axils wide and rounded. Laciniae from $\frac{1}{2}$ cm. to $1\frac{1}{2}$ cm. broad, nearly linear throughout, with toothed margins and blunt apices. The substance is not gelatinous, and the plants do not adhere to the mounting paper. Colour rosy-red when fresh.

Western Australia and South Australia (Eastern Bays).

The genus should probably be placed under the family Rhodophyllidaceae rather than under Rhodymeniaceae, but its position cannot be determined until the cystocarps have been found.

RHODYMENIA Greville.

Frond flat, membranaceous, dichotomous or palmate, composed of two strata of cells, the interior of large, uncoloured oblong cells in a few layers, the cortical of minute-coloured cells radiating vertically. Cystocarps scattered over the frond, with a hemispherical pericarp. Tetrasporangia evolved among the superficial cells, rounded, cruciately divided. Colour red. Substance firm, chartaceous.

A world-wide genus with six or seven Australian representatives, which rarely produce cystocarps.

Frankly, I find it impossible to distinguish categorically our so-called species. *Rhodymenias* are common with us, in all the States of the Commonwealth, but they are rarely found fruiting. European phycologists apparently have had similar difficulties. In his monograph "Die Floridenordnung Rhodymeniales," 1931, Kylin has given great help by producing photographic figures of the original types of *leptophylla*, *linearis*,

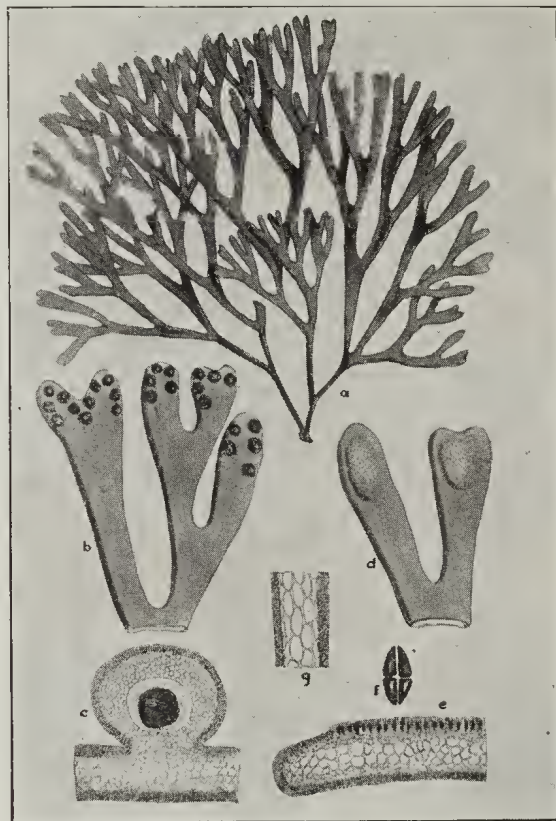


Fig. 65.—*Rhodymenia australis*: a, plant; b, apices, bearing cystocarps; c, vertical section of a cystocarp; d, apices, bearing nemathecia; e, cross-section of lamina and nemathecium; f, a tetraspore; g, longitudinal section of lamina. (After Harvey.)

foliifera, and *stenoglossa*, as also of Bory's *corallina*. Harvey identified one of our forms (or perhaps more) as *R. corallina* of Chile and Peru and Magellan's Straits, but his identification is reprobated by later writers.

The following rough grouping of our species may be of some use in guiding collectors. Fruiting forms, sexual and non-sexual, are needed in quantity before an exact taxonomy can be proposed.

A.—Frond from the base broad, 3 mm. to 4 mm., and palmately spreading in repeated dichotomies, apices rounded, blunt. Ten cm. to 15 cm. in height and spread.

R. foliifera Harv. and *R. australis* (Sond.) Harvey. I cannot distinguish them.

B.—Frond from the base narrow, 1 mm. to 2 mm., flabellate in dichotomies. Apices less blunt. Six cm. to 10 cm. long.

R. leptophylla J. Ag. and *R. linearis* J. Ag. Kylin is at a loss to narrowly characterize the latter.

C.—Frond with a narrow cuneate-linear stipe, dichotomo-fastigiate, proliferating again and again from truncated apices. Ten cm. to 15 cm. long.

R. prolificans Zan. "Perhaps only a variety of *R. australis*" De Toni. Very many stems, erect, at base filiform, soon canaliculately flat, passing into a very narrow, 1.5 mm. frond. Older plants beset with strap-shaped marginal processes. About 15 cm. long.

SEBDENIA Berthold.

Frond compressed flat, sometimes laxly tubulose, forked or irregularly lacinate or lobed, rather thick and rigid. Interior stratum of more or less loosely packed branching articulate fibres; surrounded by a context of several series of cells. Cystocarps scattered, small and but little projecting above the surface of the frond. Tetrasporangia nidulating among the cells of the cortex, cruciately divided.

Sebdenia kallymenioides (Harv.) De Toni.

Frond broadly expanded above a stipe, thinly membranaceous, flat, profoundly incised, the thicker margin beset with minute glands.

GLOIOSACCION Harvey.

Frond bag-like, filled with transparent gelatine, rising from a short cylindrical stipe which is attached by a small conical disc. Composed of three strata; the inner of very large gelatinous cells soon ruptured to leave a cavity; the intermediate of roundish-angular coloured cells; the cortical of minute cells set in vertical filaments. Cystocarps immersed in the intermediate stratum and composed of numerous confluent nucleoli.

Gloiosaccion Brownii Harvey.

The only species, 6 cm. to 30 cm. high, 2 cm. to 5 cm. in diameter, fusiform or sausage-shaped, the adult bags filled with a transparent jelly. Colour from rose-red to livid-purple.

Western and South Australia, Victoria, Tasmania.

Removed to *Chrysymenia* by De Toni but restored by Kylin.



Fig. 66.—*Gloiosaccion Brownii*: a, plants; b, section of membrane to show cellular structure; c, section through a favellidium. (After Harvey.)

CHRYSYMENIA J. Agardh.

Frond sub-terete or plano-compressed (or with a solid branching stem), branched; the tube empty or with percurrent filaments; peripheric stratum composed internally of large, roundish-angular, inflated cells, externally of minute, coloured vertically seriated cellules. Conceptacles half-immersed in the frond, hemispherical or conical, containing a simple nucleus (favella) fixed to a basal placenta, surrounded by anastomosing filaments, and consisting of very numerous, densely packed, minute spores, enclosed in a membrane. Tetraspores cruciate, scattered among the superficial cells of the periphery.

Chrysymenia obovata Sonder.

Frond filiform, solid, irregularly dichotomous; the branches set with obovate, crowded, bag-like, horny-membranous ramuli; conceptacles hemispherical.

Very common on the western and southern shores of Australia. Collected in South Australia from Holdfast Bay, Encounter Bay.

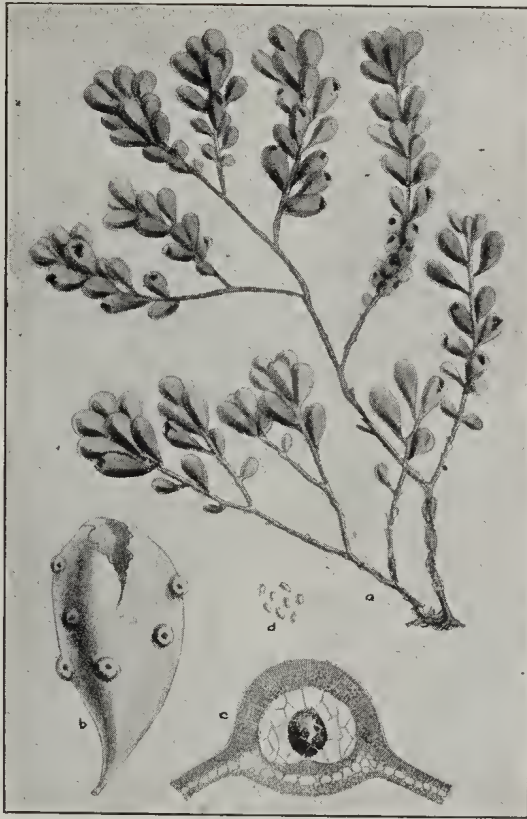


Fig. 67.—*Chrysymenia obovata*: a, plant; b, one of the ramuli, bearing conceptacles; c, section of a conceptacle, with part of the periphery of the ramulus; d, spores. (After Harvey.)

BINDERA Harvey.

Frond cylindrical saccate, branching with similar proliferations, the external membrane consisting of three strata, the inner of large oblong cells, the intermediate of smaller angular cells, the outer of strings of minute moniliform cells at right angles to the surface of the frond. Cystocarps sub-immersed. Tetrasporangia immersed in the cortical stratum, cruciately divided. Confined to Australia, Tasmania.

Bindera splachnoides Harvey.

Frond cylindrical, bag-shaped, hollow, with similar decompound branches. Holdfast a small disc. Frond 7 cm. to 15 cm. high, filled with a gelatinous substance. Tetrasporangia collected in sori, immersed, cruciately divided. Colour rosy, but fading to pale-brown. According to Kylin *Halymenia saccata* is identical with *B. splachnoides*.

In deeper water from Western Australia to Port Phillip Heads and Northern Tasmania. Collected in South Australia from Sturt Bay.

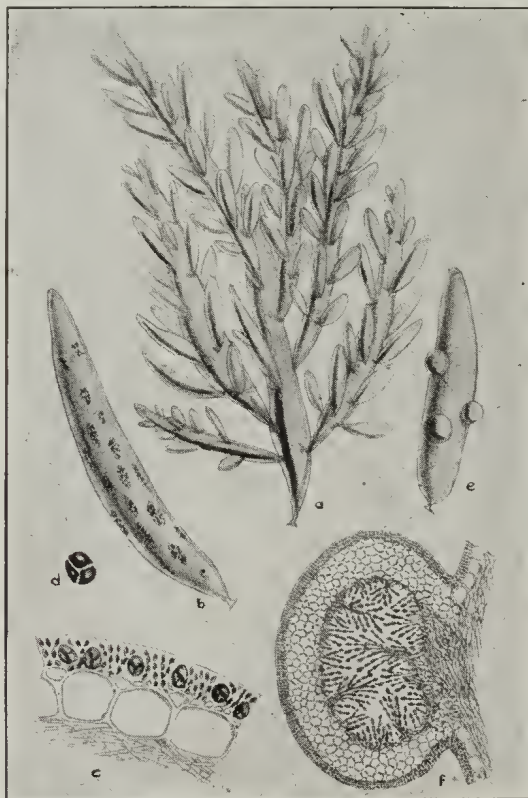


Fig. 68.—*Bindera splachnoides*: a, plant; b, a branch, containing sori; c, section through the membrane of same, showing tetraspores *in situ*; d, a tetraspore; e, a branch, with conceptacles; f, a section through a conceptacle. (After Harvey.)

Bindera kaliformis J. Agardh.

Frond decompound pinnate with branches articuately constricted below, the constrictions emitting similar branches in superposed verticils, apices obtuse. Joints of main branches 2.5 cm. to 3 cm. long. Tetrasporangia cruciate in sori on the upper surface of the thallus.

South Australia (Waterloo Bay).

BINDERELLA Schmitz.

Harvey confused two plants in describing and figuring *Bindera splachnoides*. The second plant served Schmitz for the establishment of a new genus, which he named *Binderella*. It differs from *Bindera* in structure; within is a medullary fascicle of longitudinal threads; outside this are large cells as in *Bindera*; outside these again smaller cells occur in the angles between the large cells. Hence a surface view under the microscope shows the large cells surrounded by a ring of small cells, giving the rosulate appearance of a similar view, characteristic of *Rhodophyllis*. The cystocarps are prominent, scattered on both faces of the frond. Tetrasporangia have not been observed. The position of *Binderella* cannot be certain until the tetraspores are found. Schmitz placed it among *Gelidiaceae*.

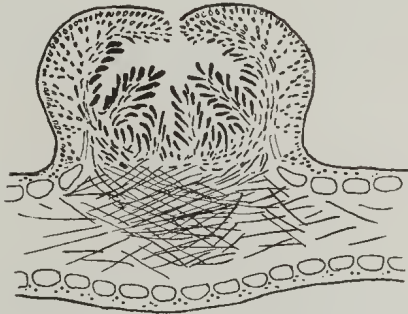


Fig. 69.—*Binderella neglecta*: Section through a cystocarp.

The plant has had a curious fate. Harvey confounded it with *Bindera*. J. Agardh described it twice, first as *Amphipleria hymenocladoides* from plants collected by Wilson at Port Phillip Heads, and secondly as *Champia circumcincta* from plants collected by Miss Hussey from Port Elliot.

The genus contains only the one species, *Binderella neglecta* Schmitz.

CHAMPIA Desvaux.

Erect fronds cylindrical or somewhat compressed gelatinous, oppositely pinnate, tubulose, the tube divided by cross-cellular dissepiments, the septa sometimes connected sparingly by threads running through the contents of the tube from one to another. The tube is enclosed by a peripheric stratum of rounded-angular cells, the inner ones larger. Cystocarps ovate on the branches. Tetrasporangia evolved in infra-cortical cells, aggregated, large, spherical, triangularly divided. A genus of wide distribution with six Australian species, of which four have been found in South Australia.

A.—Fronds cylindrical, scarcely compressed.

1. Dwarf, 3 cm. to 7 cm. long, much less than 1 mm. wide, in globose bushes, the branches

densely intricate so that they can scarcely be separated without tearing. The younger branches show the constrictions and diaphragms, in the older these are obscured.

Colour purple *C. parvula* (Ag.)
J. Agardh.

South Australia (Eastern Bays).

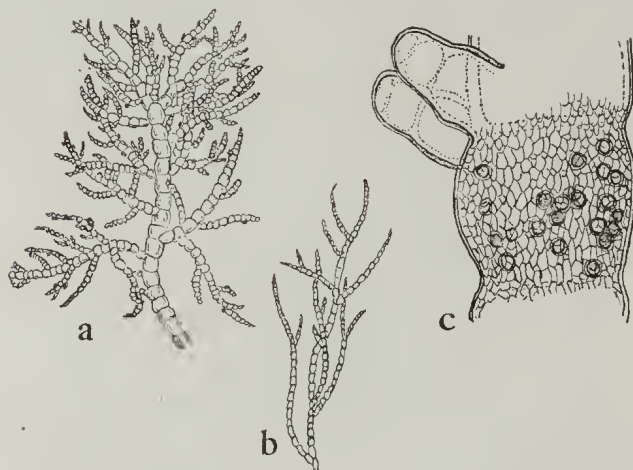


Fig. 70.—*Champia parvula*: a, sturdy form of the cystocarpic plant, showing habit of part of one main branch; b, habit of small portion of a more slender form; c, surface view of portion of a tetrasporangial branch, with several subcortical tetrasporangia and two branch rudiments. (After Taylor.)

2. Frond 15 cm. to 30 cm. long, 1 mm. to 2 mm. diameter, paniculately branching; branches opposite, alternate or whorled. Constrictions and diaphragms conspicuous. Terminal branches often hooked. Colour flesh-purple *C. affinis*

(H. & H.) J. Agardh.

South Australia (Investigator Strait, Eastern Bays).

3. Frond like that of *affinis* but the constrictions and diaphragms completely masked. Probably only a form of *affinis* *C. obsoleta*

Harvey.

South Australia (Eastern Bays).

B.—Fronds obviously compressed.

1. Dwarf, 2 cm. to 5 cm. high, 3 mm. to 4 mm. wide, almost flat, growing in small clumps, mostly bi-pinnate in branching, the branches tapering at both ends. Dissepiments prominent. Colour a reddish-purple, the plants showing a blue fluorescence when growing. A shallow water form *C. compressa*.

Harvey.

South Africa, New Caledonia, Ceylon, Australia (?).

2. Frond medium, 7 cm. to 12 cm. long, 1 mm. to 2 mm. diameter, somewhat compressed, verticillate branching, but not strongly. The ultimate segments of axis and branches projecting without ramuli. Colour dark-purple

C. tasmanica

Harvey.

South Australia (Encounter Bay, Port Noarlunga, Investigator Strait, Eastern Bays).

3. Frond large, 18 cm. long, to 5 mm. diameter, compressed, bi-tri-pinnate, the main rachis conspicuously persistent. Primary branches alternate, 5 mm. to 6 mm. distant, distichously spread. Dissepiments conspicuous. Colour a bright-purple. Substance gelatinous succose

C. insignis Lucas.

So far, only met with in the estuary of the Derwent, Tasmania.

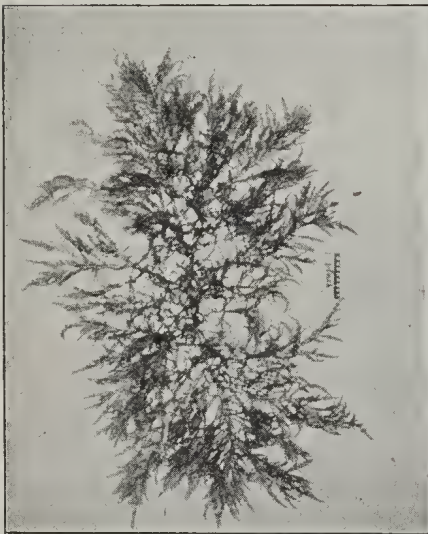


Fig. 71.—*Champia affinis*.



Fig. 72.—*Champia tasmanica*.

CHYLOCLADIA Greville.

Fronds cylindrical or slightly compressed, vaguely branching, with a narrow tubular canal in the interior, gelatinous-membranaceous. Composed of two strata of cells, the interior of jointed threads which traverse the tube, the peripheric of rounded-angular cells in several series, the outer smaller, rounded and coloured. Cystocarps within an external pericarp, nucleus simple oblong, girt by a labyrinth of fine reticulating and anastomosing threads. Tetrasporangia aggregated in dilated branches, large, spherical, triangularly divided.

Chyloc'adia fruticulosa (Reinbold) De Toni.

A dwarf plant less than an inch high, epiphytic on *Cymodocea*. Fronds caespitose, terete, densely branched laterally. Cystocarps large, subglobose. Tetrasporangia in somewhat dilated ramuli.

South Australia (Investigator Strait).

ERYTHROCOLON J. Agardh.

Frond constricted into large joints separated by narrow isthmuses, branches di-trichotomous or verticillate. Interior cells very large, rounded-cubical disposed parallel to the face of the frond, at length gelatinous and gradually dissolved in the inflated or hollow frond; exterior cells much smaller, crowded, coloured. Cystoc̄arps scattered over the internodes, small, prominent, containing within the large hollow periearp a small simple basal nucleus. Tetrasporangia not seen in Australian species.

Erythrocolon Muelleri (Sond.) De Toni.

A short, solid, cartilaginous stipe breaking up into numerous trichotomous branches 10 cm. to 15 cm. high. Branches fastigiate, pretty regularly trichotomous, constricted into joint-like oblong internodes, 6 mm. to 20 mm. long, separated by short, narrow, solid nodes. The terminal internodes ovate, the basal long and pyriform. Colour a dull purplish-red.

Western Australia, South Australia (LeFevre Peninsula, Investigator Strait and Robe); New South Wales (Botany Bay).

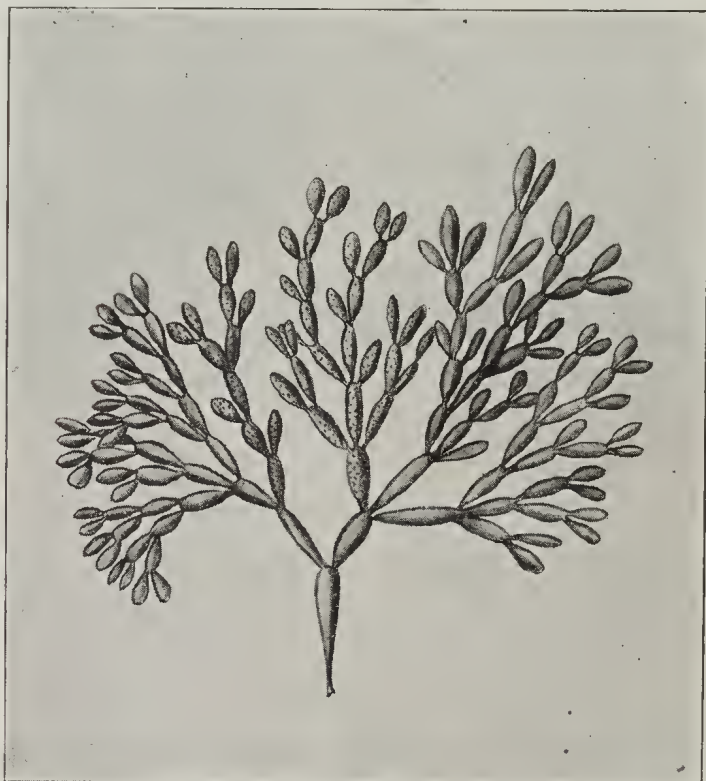


Fig. 73.—*Erythrocolon Muelleri*: Some branches with minute cystocarps.

Subfamily Plocamieae (Reichb.) Kützing.

The characters are those of the single genus *Plocamium*.

PLOCAMIUM Lamouroux.

Fronds erect, narrowly linear, more or less compressed, the rami and ramuli spreading distichously in one plane. Membranaceous, not gelatinous or mucous. The interior cells longitudinal, oblong, the cortical cells roundish-angular, filled with red endochrome. The primary branching alternate with wide angles. The rachides of rami and ramuli are fringed with characteristic series of ramelli arranged alternately on each margin of the rachis. The ramelli are in pairs or there may be three, four or more in a second or pectinate series, the lowest simple, the rest pinnulate and more or less decomposed. Cystocarps and tetrasporangia on different individuals. Cystocarps single, sessile on the margin of the pinnule, or aggregated in the axils, with a thick pericarp, the spores carried on thin paniculately branching threads without evident placenta. Tetrasporangia zonately divided in two longitudinal series in the sporophylls, modified ramelli; the sporophylls borne on the ramuli, then stellately or pinnately branched, or aggregated in the axils and then simple linear, areolate. Antheridia evolved in superficial sori, of minute hyaline cells. Colour red of various shades. From the elegance of their fronds and the richness of their colour the plants of *Plocamium* are strikingly attractive.

A genus occurring in the temperate seas of both hemispheres, but having its headquarters in the Southern Ocean, the Cape of Good Hope, Australia, Tasmania, and New Zealand. *P. coccineum* the favourite of British collectors, closely allied to our *P. leptophyllum* if not identical with it, has been gathered at Cape Horn and by the Mawson Expedition in Commonwealth Bay of the Antarctic Continent. Of the 30 species described 11 are Australian. All have been gathered in South Australia except *P. patagiatum*, so far recorded from Tasmania only. They grow on the rocks in fairly deep water near the land.

The genus may be divided into three groups.

A.—Alternating series of three or more pinnellae. Cystocarps sessile on the margins of the ramuli, solitary.

1. Sporophylls marginal, branched. Laciniae entire.

Rami-slender, 1 mm. diameter *P. leptophyllum*
Kützling.

South Australia (Investigator Strait, Eastern Bays).

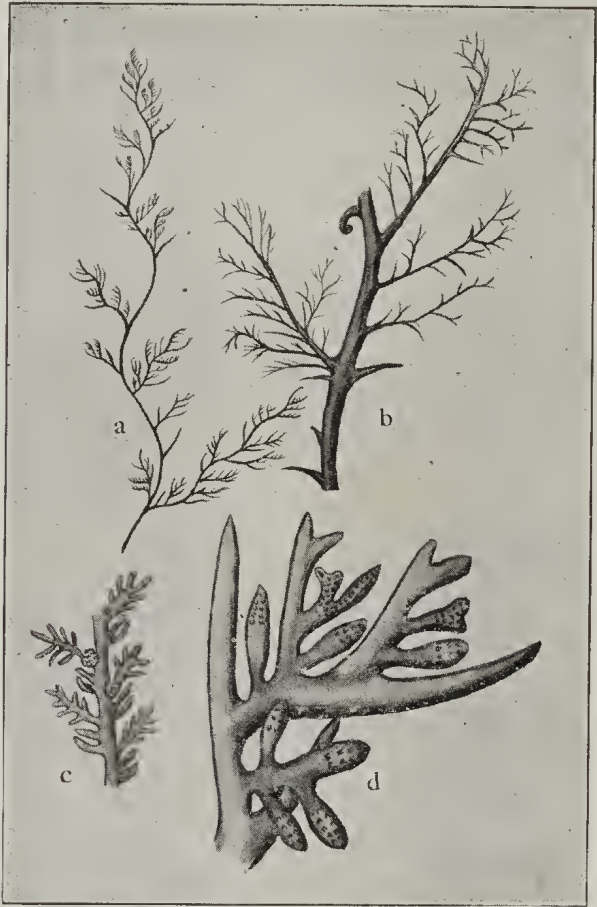


Fig. 74.—*Plocamium leptophyllum*: *a* and *b*, plants (*b*, enlarged); *c*, cystocarps; *d*, tetrasporangia.

2. Sporophylls axillary, clustered, simple, arcuate.

Laciniae serrate. Rami broader, to 3 mm.

diameter *P. Preissianum*
Sonder.

South Australia (Encounter Bay, Eastern Bays).



Fig. 75.—*Plocamium Preissianum*: a, plant; b, part of a pinna, with conceptacles; c, vertical section through a conceptacle and branch; d, part of a pinna with axillary stichidia; e, three of the stichidia removed; f, a tetraspore. (After Harvey.)

(*P. homatum* J. Ag. is like *P. leptophyllum*, but is of a brighter red, and the lowest of the alternating pinnellae is recurved in a prominent hook. It grows on Lord Howe and Norfolk Islands and on the coast of Queensland 50 miles north of Brisbane.)

B.—Alternating series of pinnellae in pairs. Cystocarps sessile on the margin of the ramuli.

1. Sporophylls in the axils, bushy, branched.

Laciniae mostly entire. Rami slender, 1 mm.;

not ribbed *P. angustum*

(J. Ag.) Hooker and Harvey.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays).

2. Sporophylls in axillary tufts, branched.

Laciniae serrate. Rami broad, 3 mm.,

costate *P. costatum*

(J. Ag.) Hooker and Harvey.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays).

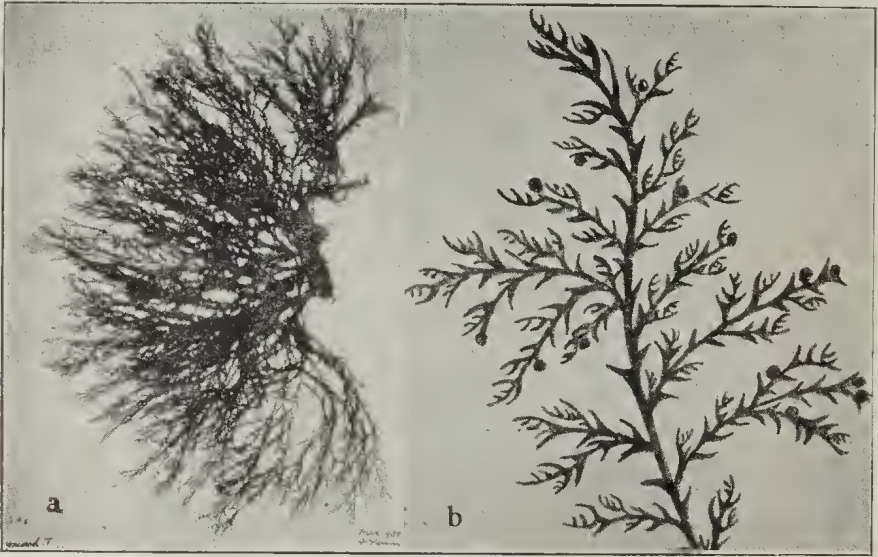


Fig. 76.—*Plocamium angustum*: a, plant; b, branch with cystocarps.



Fig. 77.—*Plocamium costatum*: a, plant; b, branch with clusters of cystocarps.

3. Sporophylls flabellately radiating, subseriate on the minor pinnules, simple, lanceolate, pedicellate. Lacinae entire. Rami very slender; 5 mm., ecostate

P. gracile

J. Agardh.

Tasmania.



Fig. 78.—*Plocamium gracile*.

C.—Alternating series of pairs of pinellae. Cystocarps at length fasciculate in the axils, singly pedicellate.

1. Sporophylls fasciculate in the axils, simple, pod-like. Lacinae bushy, inferior short, dichotomously decompound, much like the superior but serrate. Rami narrower, 1 mm to 2 mm.

P. nidificum

(Harv.) J. Agardh.

South Australia (Enconunter Bay, Investigator Strait, Eastern Bays).

2, 3. Sporophylls clustered, simple, pod-like. Rami broader, 2 mm. to 3 mm., ecostate.

- (2) Laciniae entire *P. procerum*
(J. Ag.) Harvey.

South Australia (Encounter Bay, Eastern Bays, Great Australian Bight).



Fig. 79.—*Plocamium procerum*: *a* and *b*, plants (*a*, enlarged); *c*, portion of thallus with conceptacles; *d*, section of a conceptacle; *e*, spore strings; *f*, fragment of the thallus showing stichidia; *g*, two of the stichidia; *h*, a tetraspore. (After Harvey.)

- (3) *Laciniae serrate* *P. Mertensii*
 (Grev.) Harvey.
 South Australia (Encounter Bay,
 Eastern Bays).



Fig. 80.—*Plocamium Mertensii*.

4. Sporophylls clustered in a dense glomerulus,
 single with simple branches, pedicellate.
Laciniae entire, subulate. Rami broad, sub-
 ecostate, 3 mm. *P. patagiatum*
 J. Agardh.
 Tasmania.
5. Sporophylls simple, clavate oblong, pedicellate,
 clustered in the axils. *Laciniae* serrate.
 Rami broad, thickened medially or with a
 less developed midrib, 3 mm. *P. dilatatum*
 J. Agardh.
 South Australia (Eastern Bays).

Family DELESSERIACEAE (Naegeli) Schmitz.

Fronds mostly flat, sometimes latticed, simple or variously lobed, costate or ecostate, parenchymatous. Procarps disposed in the mid-stratum of the thallus. Gonimoblast sessile in the thallus evolved in a cavity covered by a cortex adnate to the middle of a thickened placenta. Carpospores at the apices of fertile ramuli. Tetrasporangia often collected in sori, or borne on special leaflets, triangularly divided. "In this family are included perhaps the most beautiful of all algae. Rose-red in colour, leaf-like, some with midribs (and veins), some with a delicate or net-like structure, all are remarkable for their attractive form." (Tilden.)

CONSPECTUS OF THE SUBFAMILIES.

- I.—Apical cell mostly indistinct. Cystocarps outwardly prominent. Lobes of the gonimoblast closely coalescing *Nitophylleae*.
- II.—Apical cell conspicuous, transversely articulated at the apex of the vegetative frond.
1. Tetrasporangia evolved in both surfaces of the frond. Cystocarps mostly prominent on both faces *Delesserieae*.
 2. Tetrasporangia in special stichidia or otherwise conspicuous. Cystocarps stout, sub-globose prominent *Sarcomenieae*.

Subfamily Nitophylleae (Naegeli) Schmitz.

CONSPECTUS OF THE GENERA.

- A.—Frond broad, flabellate, leaf-like, proliferating from the margins, fenestrated *Martensia* Hering.
- B.—Frond flat, foliaceous, continuously membranaceous.
1. Cortical cells sub-hexagonal. Sori definite, scattered *Nitophyllum*
Greville.
 2. Cortical cells arranged in twos or fours, like those of *Porphyra*. Sori showing minute scattered dots *Platyclinia*
J. Agardh.
 3. Cortical cells sub-cubical. Frond thick and coarse. Sori in linear furrows within the margin *Pachyglossum*
J. Agardh.

MARTENSIA Hering.

Frond flat, simple or dichotomous, or divided into lobes from the base, segments rounded flabellate, the lower area of each areolate-cellular, continuous, the upper forming a network of longitudinal and horizontal trabeculae. Some fronds proliferate from the margin, the new segments also with continuous lower area and trellised upper area. Cystocarps sessile on the walls of the trellis, solitary, scattered, globose; pyriform spores at the ends of threads radiating from a central placenta, within a cellular pericarp. Tetrasporangia sub-seriate in the walls of the trellis, triangularly divided.

Cape of Good Hope, Ceylon, Friendly Islands, and Australia.

Martensia denticulata Harvey.

Repeatedly dichotomous, 5 cm. to 8 cm. high, the upper margin toothed or lobed. Colour when fresh a greenish-purple, iridescent; on exposure to the air or in fresh water becoming rosy or blood-red.

South-West Australia.

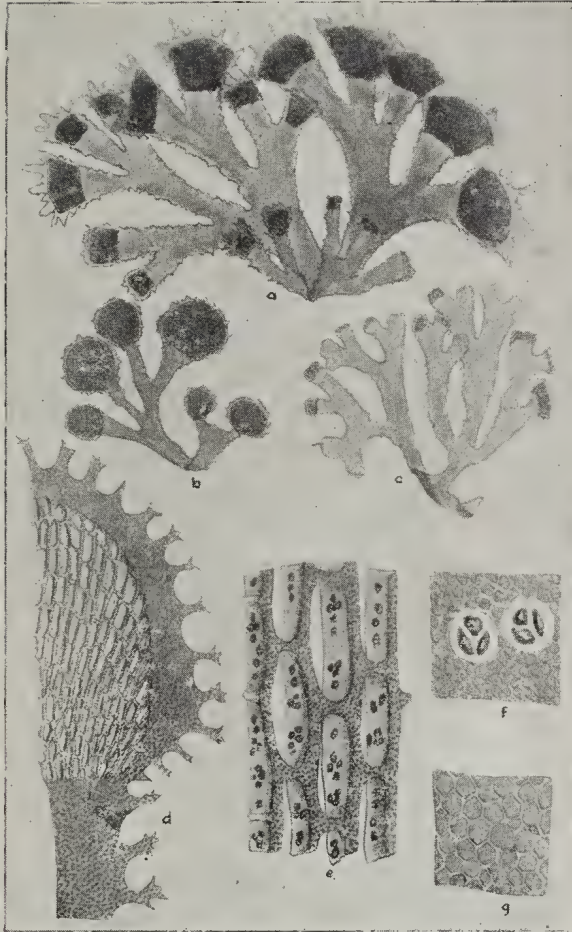


Fig. 81.—*Martensia denticulata*: a, b, and c, different varieties; d, portion of the lamina, showing the toothed margin, and part of a network; e, small portions of a network, bearing tetraspores on the longitudinal bars; f, tetraspores *in situ*; g, surface cells from the basal portion of the frond. (After Harvey.)



Fig. 82.—*Martensia elegans*. (After Tilden.)

Martensia elegans Hering.

Inconspicuously forked, flabellate. Margin not toothed. Colour when growing brown-fawn, on drying red.

South Africa, Australia from Fremantle to Newcastle.

I regard the large fragments thrown up at times and labelled *M. australis* and *M. gigas* by Harvey as being coarse "old man" forms of *M. elegans*.

NITOPHYLLUM Greville.

Fronds flat, expanded in one plane, or narrow, almost linear dichotomous or pinnate, more usually broader cuneate-flabelliform or palmatisect, sessile or stipitate. Fronds thinly or more firmly membranaceous, consisting of one or more strata of rounded or angular sub-hexagonal cells filled with colouring matter usually rose-coloured but sometimes of a duller red or purple, the surface cells giving to the frond, as seen from the surface by aid of the microscope, a beautifully areolated appearance. Cystocarps and tetrasporangia borne on different individuals. Cystocarps sessile on the frond, depressed, with a wide basal placenta which bears clavate-ovate carpospores within a radiate cellular pericarp through an opening in which (carpostomium) the spores escape. Nothing seems to be known of the antheridia. The tetrasporangia are rounded, divided tetrahedrally into four spores, and occur in definite groups (sori) which may be scattered over the surface or be local in their disposition.

A world-spread genus, with about 24 Australian species. It has been divided up into small new genera by Kylin.

KEY TO THE SUBGENERA.

J. Agardh divided the genus into four subgenera, basing his classification on the development of the veins.

1. *Leptostroma*.—Monostromatic, veinless, European.
2. *Aglaophyllum*.—Di-pleio-stromatic, veinless.
3. *Cryptoneura*.—Di-pleio-stromatic, veins present inconspicuous.
4. *Polyneura*.—Di-pleio-stromatic, veins well developed, conspicuous.

Subgenus AGLAOPHYLLUM.

Three species have been recorded from South Australia, *N. Gunnianum*, *N. erosum*, and *N. pristoideum*.

- A.—Frond shortly stipitate, thinly membranaceous, veinless, the margins densely undulate, produced into oblong laciniae. Cystocarps chiefly on the laciniae. Colour rose-red *N. crispum*
(Kuetz) J. Ag.

- B.—Frond dilated with broadly cuneate segments, the margin armed with small teeth bent alternately upwards and downwards, visible under a lens *N. Gunnianum*
Harvey.
(*Myriogramme Gunniana* (Harv.) Kylin).

C.—Frond pinnately decompound, younger segments linear or oblong, flat, armed with a dentate, serrated or fimbriated margin, the lower portion of the frond with a thickened costal region forming a more or less apparent thickened midrib.

1. Very short stipe passing into the cuneate base of a broadly linear, dichotomo-multifid frond. Margin everywhere fringed with minute multifid processes *N. erosum*
Harvey.
(*Myriogramme erosa* (Harv.) Kylin).

2. Frond with an elongated stipe 2 mm. to 4 mm. wide, decompound caulescent, the upper segments flabelliform-fastigiate, crenulate at the margin with minute, rather acute teeth *N. pristoideum*
Harv.
(*Myriogramme pristoidea* (Harv.) Kylin).



Fig. 83.—*Nitophyllum crispum*.

Nitophyllum Gunnianum Harvey.

Frond with a short stipe to 3 mm. long, broadly membranaceous, profoundly sub-palmato-laciniate, the lacinae broad, 2 cm. to 10 cm. wide, with narrow axils and blunt apices. Whole frond 15 cm. to 25 cm. long, 20 cm. to 30 cm. wide. In older plants the frond riddled with roundish holes. Cystocarps less than 1 mm. in diameter, dark-coloured and sprinkled over the frond. Sori of tetrasporangia very minute, dispersed over the frond. Colour sometimes rosy, sometimes dark-purple.

The Southern States and Tasmania.



Fig. 84.—*Nitophyllum Gunnianum*: a, plant; b, section through a cystocarp and the frond; c, strings of spores from the same; d, small portion of the surface and of the erose margin. (After Harvey.)

Nitophyllum erosum Harvey.

Laciniae linear obtuse, 8 mm. to 10 mm. wide, with wide axils. Cystocarps sparingly scattered over the frond, crowned with forked processes like those of the margin. Frond 2 cm. to 10 cm. long. Sori oblong or oval, $\frac{1}{2}$ mm. long, thickly strewn over the surface of the frond. Colour a full deep-red.

Western Australia, South Australia (Eastern Bays), Victoria.

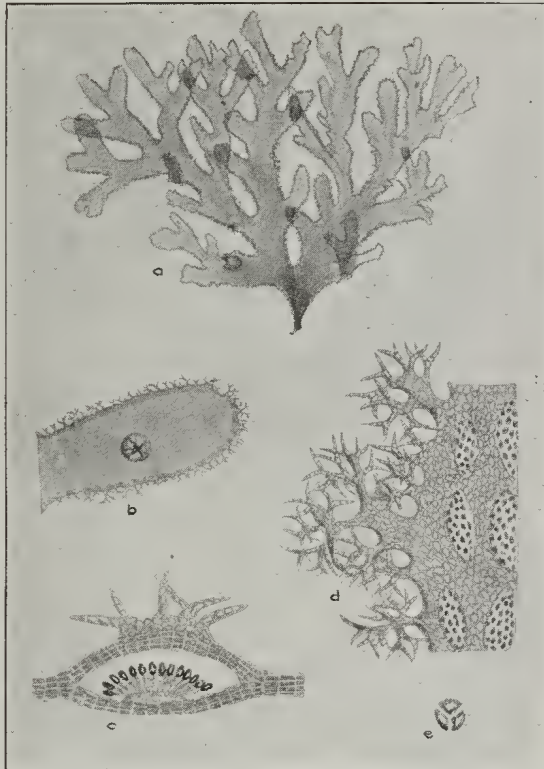


Fig. 85.—*Nitophyllum erosum*: a, plant; b, part of a lacinia, with a conceptacle; c, vertical section of a conceptacle; d, frusticle of frond, to show marginal fringe and sori; e, tetraspore. (After Harvey.)

Nitophyllum pristoideum Harvey.

Frond 10 cm. to 20 cm. high and 8 cm. to 15 cm. in lateral spread, excessively decompound, the greater and lesser branches of nearly uniform breadth about 4 mm. in diameter. Cystocarps most frequent near the ends of the segments. Sori crowded in the ultimate divisions of the frond. Colour a dull dark-red, browner on drying. Substance rather rigidly membranous.

South Australia (Encounter Bay, Eastern Bays) and Victoria.

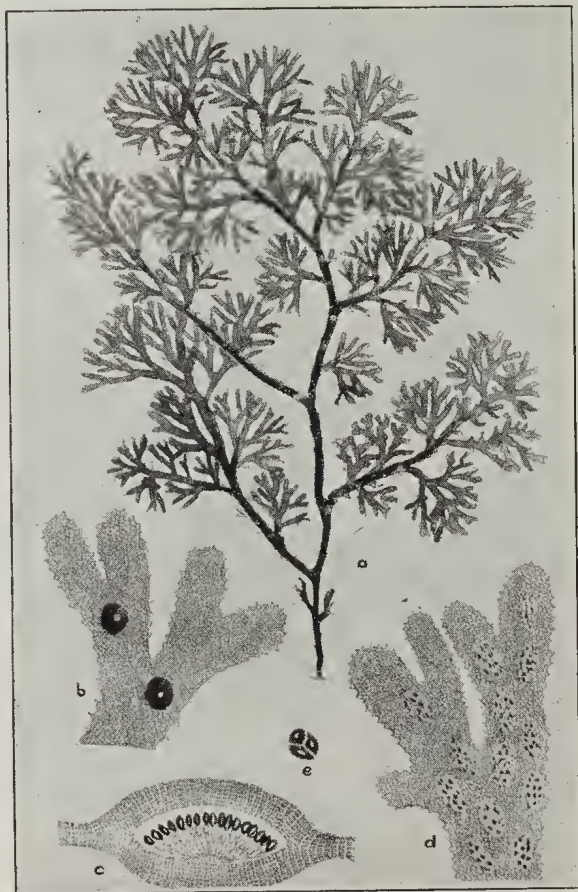


Fig. 86.—*Nitophyllum pristoideum*: a, plant; b, apex with cystocarps; c, section of a cystocarp; d, apex with sori of tetraspores; e, tetraspore. (After Harvey.)

Subgenus CRYPTONEURA.

1. Fronds elongate, to 15 cm. long, narrow, 2 mm. to 4.5 mm. wide, growing up amongst other algae and clinging to them here and there by a lobe transformed into a cirrhus, other lobes often

lateral and dilated, generating a solitary sorus within the margin. Colour rosy-red *N. uncinatum*
 (Turn.) J. Agardh.
(Acrosonium uncinatum (J. Ag.) Kylin).

2. Frond narrow, almost freely expanded, not clinging to other plants by hooks, more or less dilated above the middle, bearing above lobes more or less palmately decompound, ultimate rounded obtuse, at length generating a solitary sorus in the disc. Small, 2 cm. to 4 cm. long, 1 mm. to 3 mm wide *N. minus* (Sond.)
 Harvey.
(Acrosonium minus (Sond.) Kylin).

South Australia (Eastern Bays).

3. Frond broad, dilated and fan-shaped above, membranaceous, finely-veined even to the apices. Sori numerous, scattered, especially evolved in upper pinnate-lobed segments. Colour sordidly purpleseent. 10 cm. to 15 cm. long.
- a. Scarcely or not eaulescent below *N. affine* Harvey
(Hymenema affinis (Harv.) Kylin).
- Reeorded in South Australia from Encounter Bay and Eastern Bays.
- b. Markedly eaulescent below *N. Curdieanum*
 Harvey.
(Hymenema Curdieana (Harv.) Kylin).

in which I include *N. validum* J. Agardh and *N. polyanthum* J. Agardh. These species have been reeorded from Encounter Bay, Gulf St. Vineent, Investigator Strait, and Eastern Bays.



Fig. 87.—*Nitophyllum affine*.

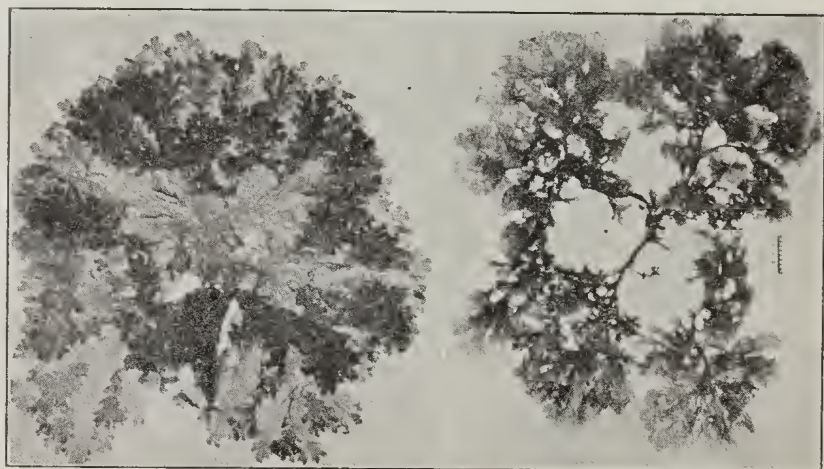


Fig. 88.—*Nitophyllum affine*: *Variant*.



Fig 89.—*Nitophyllum Curdieanum*.

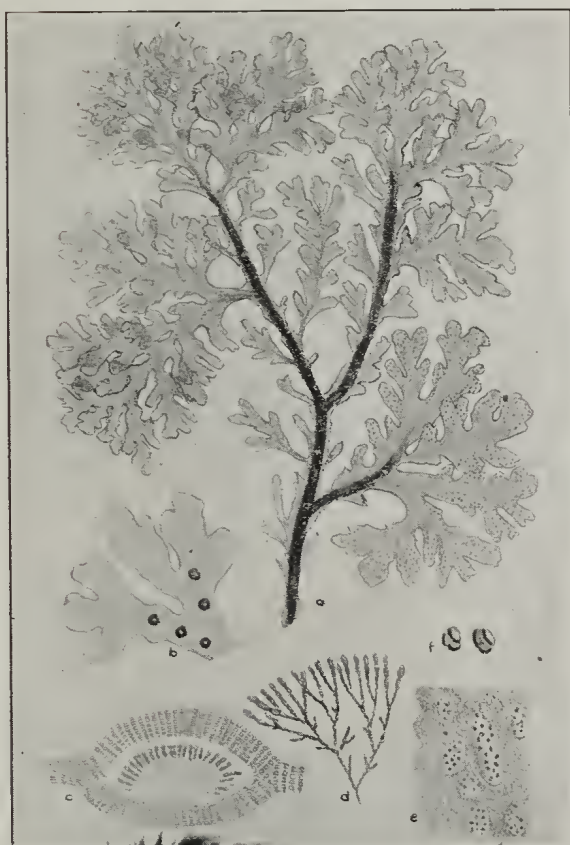


Fig. 90.—*Nitophyllum Curdieanum*: *a*, plant; *b*, a fragment of a segment, bearing cystocarps; *c*, section through a cystocarp; *d*, spore thread; *e*, frusticle, with sori; *f*, tetraspores. (After Harvey.)

PLATYCLINIA J. Agardh.

Frond flat, foliaceous, more or less lobed or dissected, membranaceous, the upper parts consisting of three, the lower of more layers. The innermost cells a little larger, the middle shorter, the outermost shorter by half, arranged in twos or fours after the fashion of *Porphyra*. Ribs and microscopic veins are wanting. Cystocarps sub-immersed, scattered, depressed, with the carpospores in chains. Tetrasporangia rather small, scattered.

Cape Horn, Campbell Island (New Zealand), Australia.

Platyclinia stipitata (Harv.) J. Agardh.

Frond with a stipe 2 cm. to 3 cm. long, dilated above into a fan-shaped lamina, 5 cm. to 10 cm. in expansion, upper segments pedatifid with lanceolate-linear laciniae. Substance mucous. Colour rosy-red.

South Australia (Port Elliot), Tasmania.

Platyclinia purpurea J. Agardh.

Frond with sub-dichotomous, acuminate laciniae. To 30 cm. high, with laciniae 10 cm. to 15 cm. long. At the base 2 cm. to 5 cm. wide. Colour dark-purple.

South Australia (Hussey).

PACHYGLOSSUM J. Agardh.

Frond flat, thick, of several layers of cells. Sori of tetraspores in linear furrows within the margins of the frond. Cystocarps sub-singly scattered in the intra-marginal region. Thallus borders smooth, without teeth.

Pachyglossum Engelhardtii J. Agardh.

Fronds linear, lanceolate proliferating from the margin; conspicuously attenuated at the base and apex. Colour rosy.

South Australia (Eastern Bays).

Pachyglossum Husseyanum J. Agardh.

Fronds proliferous, with lanceolate-linear leaflets, although several leaflets approximate in rosettes.

South Australia (Port Elliot, Eastern Bays).

Subfamily Delesserieae (Kützing) Schmitz.

CONSPECTUS OF GENERA.

A.—Sori of tetrasporangia evolved in special leaves (sporophylls).

a. No transverse veins.

1. Very thin, delicate, membranous. Conspicuous midrib. Cystocarps over the midrib. Sori of tetrasporangia in the sporophylls proliferating on each side of the midrib

Hypoglossum

Kützing.

2. Frond thick and stiff. Midrib present with long linear proliferations from it on each side. Cystocarps borne singly on sporophylls from the midrib of the linear leaves. Tetrasporangia in a sorus occupying the middle surface of the sporophyll *Chauvinia*
Harvey.
3. Frond thick, narrow. Midrib present with linear leaflets proliferating from the midrib on each side. These similarly proliferate, and so on till the frond assumes a multo-pinnate form. Cystocarps single over the midrib of a sporophyll. Tetrasporangia in twin sori on each side of the sporophyll *Phitymophora*
J. Agardh
- b. Delicate transverse veins present. Thin like *Hypoglossum* and with cystocarps and sori of tetrasporangia in sporophylls proliferating from the midrib *Apoglossum*
J. Agardh.
- B.—Sori of tetrasporangia not evolved in special sporophylls. Midrib interrupted, cystocarps imposed on the midrib. Sori of tetrasporangia forming several sub-seriate spots within the margin of the frond on each side *Hemineura*
Harvey.

HYPOGLOSSUM Kützing.

A beautiful genus of delicate texture, mainly Australian (13 species) with three exotic species. The finest are *H. dendroides* from Western Australia and *H. serrulata* from Botany Bay; each from 20 cm. to 50 cm. high. They are plants growing in deeper water, and so are rarely met with on the beach. Frond is simple, usually more or less lanceolate in outline, entire or toothed or laciniate on the margins. The midrib is conspicuous, and from it the cells pass in arcuate transverse rows to the margin. Cystocarps singly over the midrib. Sori in small sporophylls arising from either side of the midrib. Only three of the species have been recorded from South Australia, but one or two others are included below as likely inhabitants.

Hypoglossum spathulatum (Kütz.) J. Agardh.

Fronds linear-lanceolate, to 10 cm. high and 2 mm. to 6 mm. wide, narrowed at both ends. Midrib slender, jointed, composed of three layers of cells. Proliferating folioles linear-lanceolate, acuminate, with entire margins. Colour rosy-carmine.

As it is known in Western and Eastern States, will probably be found in South Australia.

Hypoglossum microdontum J. Agardh.

Folioles imbricated over midrib, margins of rachis and folioles minutely toothed.

South Australia (Encounter Bay).

Hypoglossum revolutum (Harv.) J. Agardh.

Frond dichotomous, formed of a string of strongly ribbed epiphyllous leaflets, revolute apices. Leaflets ovate-lanceolate, serrate, wavy, delicately membranous, pale-red, once and a half to twice as long as their breadth. 10 cm. to 14 cm. high, about 4 mm. wide. Colour a pale rose-red, soon discharged in fresh water. At present known from South-Western Australia.

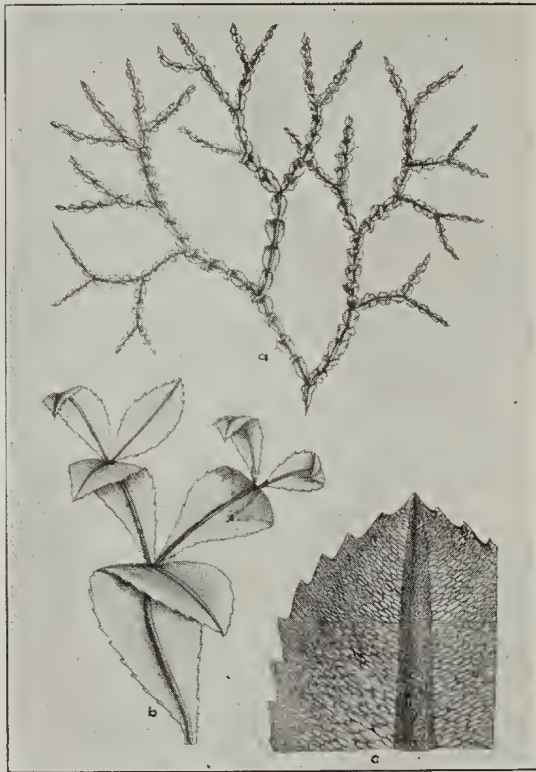


Fig. 91.—*Hypoglossum revolutum*: a, plant; b, some of the epiphyllous leaflets, forming the extremities of the frond; c, apex of a leaflet. (After Harvey.)

Hypoglossum denticulatum J. Agardh.

Less than 5 cm. high with stout midrib. Folioles decurrent on the midrib, margins with acute deltaeform teeth.

South Australia (Guichen Bay).

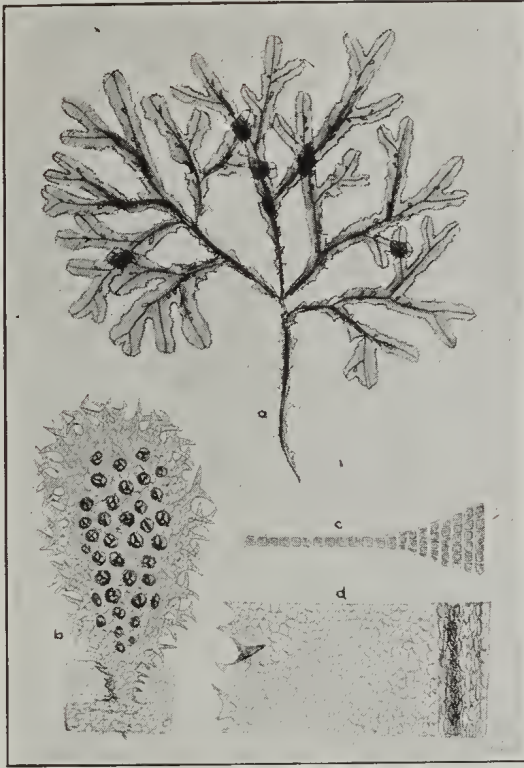


Fig. 92.—*Hypoglossum denticulatum*: a, plant; b, a fruit leaf, bearing a sorus of tetraspores; c, section of the membrane of the frond, and semi-section of the midrib; d, frustule, showing the surface cells and the toothed margin. . (After Harvey.)

Hypoglossum Lacepedeanum Reinbold.

Fifteen cm. high. Similar to preceding, but with entire margins.

South Australia (Guichen Bay, Investigator Strait). Apparently fairly rare.

CHAUVINIA Harvey.

Frond with pinnate proliferations, rachis and branches mostly linear; several layers of cells, margins entire.

Chauvinia coriifolia Harvey.

Frond 12 cm. to 20 cm. long, the larger leaves 8 cm. to 14 cm. long, to 15 mm. wide, linear-lanceolate, the apex rounded obtuse; sporophylls on the midrib of the leaves bearing cystocarps or sori of tetrasporangia. Substance thick, leathery. Colour dark-red.

Western and South Australia (Encounter Bay, Eastern Bays).



Fig. 93.—*Chauvinia coriifolia*: a, plant; b, sporophyll, containing tetraspores; c, some tetraspores; d, semi-section of the lamina in a small leaf; e, section at the midrib, in the same. (After Harvey.)

PHITYMOPHORA J. Agardh.

Characters given in the Conspectus of Genera.

Phitymophora imbricata J. Agardh.

Frond narrow linear, obtuse, entire, wavy or curled, becoming exceedingly compound by leaflets repeatedly springing from the midribs of older leaves.

Primary frond 10 cm. to 12 cm. long, 4 mm. to 5 mm. broad. Sporophylls rounded or oblong, 4 mm. to 5 mm. long and broad. Cystocarps single over the midrib of a sporophyll. Sori in pairs, one on each side of the midrib of the sporophyll. The sporophylls easily detached in fresh water, so that it is not easy to obtain a complete mount of the plant.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania.

APOGLOSSUM J. Agardh.

Resembling *Hypoglossum* in form and proliferations, but the fronds showing numerous transverse veins, invisible to the naked eye.

Apoglossum tasmanicum (F. v. M.) J. Agardh.

Frond to 14 cm. high, the lateral leaves broadly linear, entire, obtuse, to over 5 cm. long and 8 mm. broad. Beautiful rose-red.

South Australia, Victoria, Tasmania.



Fig. 94.—*Apoglossum tasmanicum*: Portion of a frond.

HEMINEURA Harvey.

Characters of the species.

Hemineura frondosa Harvey.

The frond leaf-like, sub-sessile, repeatedly pinnatifid, the marginal laciniae obtuse, serrulate; midrib of main rachis vanishing upwards, ribs of the laciniae obsolete at base and apex. Height 15 cm. to 60 cm., spread of frond the same. Cystocarps solitary on the midribs of the last segments, with an apiculate pericarp. Sori in rows along the margins of the smaller segments. Colour rosy-red, but often much diluted or faded.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania.

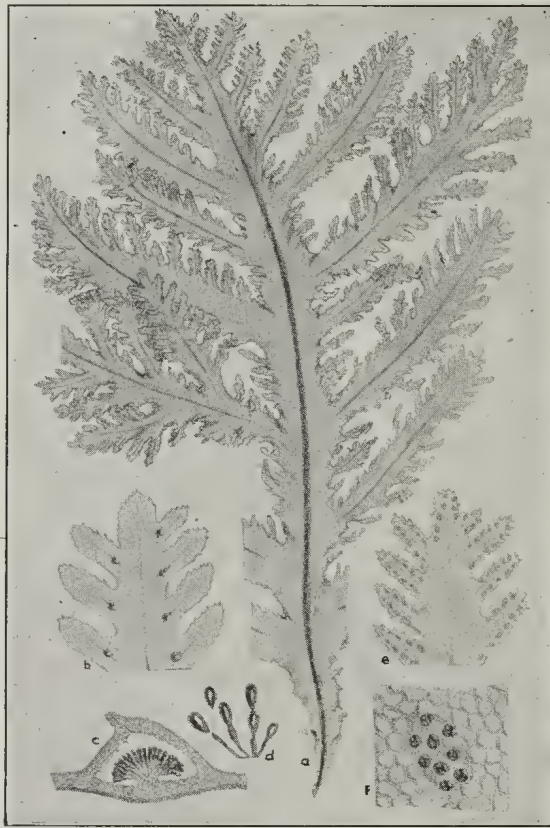


Fig. 95.—*Hemineura frondosa*: a, plant; b, apex of a frond with cystocarps *in situ*; c, vertical section of cystocarp and lamina; d, spore threads; e, apex of frond with sori; f, sorus and part of the membrane. (After Harvey.)

Subfamily Sarcomenieae Schmitz.
CONSPECTUS OF THE GENERA.

A.—Fronde continuous, nowhere forming a network.

- a. Sori scattered over the main frond *Caloglossa*
Harvey.
- b. Sori in simple foliolae, proliferating from the
frond.
1. Folioles fronded in the margin *Sarcomenia*
Sonder.
2. Folioles from the midrib as in *Hypoglossum* *Sonderella*
Schmitz.

B.—Fronde forming a network.

1. Feather-shaped, the meshes of the web of the
plume rectangular *Claudea*
Lamouroux.

CALOGLOSSA Harvey.

Fronde small, flat, dichotomous, midribbed, with a transverse series of cells, and folioles springing from the midrib, as in *Hypoglossum*. Cystocarps sessile on the midrib. Tetrasporangia in linear series from midrib to margin, triangularly divided.

Caloglossa Leprieurii (Mont.) J. Agardh.

Segments linear-lanceolate, constricted in joints. Frond to 5 cm. high, to 2 mm. broad. Tetrasporangia in parallel transverse lines. Colour violet. Attached to rocks or piles by rootlets creeping beneath the dichotomies, often growing at or above high water mark.

New South Wales, Tasmania, and Victoria in the estuaries.

SARCOMENIA Sonder.

Fronde broad or narrow, branching by intra-marginal proliferations. The structure of the frond is peculiar, with four pericentral syphon tubes, bordered on each side by two marginal syphons of half the length of the others and set end to end. Cystocarps obovate-globose, pedicellate. Folioles (stichidia) bearing tetrasporangia, these arranged in opposite pairs in two parallel rows. Colour when living light-fawn, becoming bright rosy-red in fresh water. Substance rapidly decomposing in fresh water.

A.—Ecorticate, the whole structure polysiphonious.

1. Hemispherical masses, to 5 cm. across, formed
of fine gelatinous threads, of a beautiful
cinnabar red *S. miniata* (Ag.)
J. Agardh.

2. Globose expansion to 8 cm. long formed of dichotomous-decompound branches with thin flattish branchlets bearing above crowded filaments

S. mutabilis
(Harv.) J. Agardh.

Western Australia and South Australia
(Investigator Strait).

B.—Corticate, only the junior branches polysiphonous. Caulscent tall species, 30 cm. or more high.

1. Branches opposite *S. dasyoides*

Harvey.

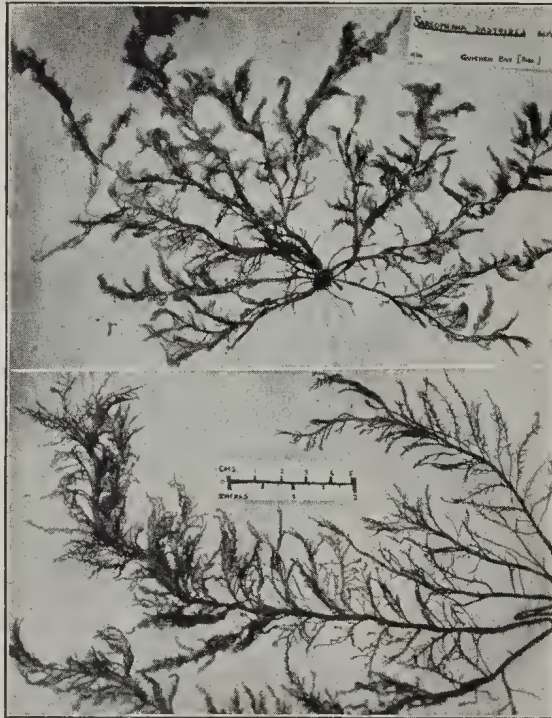


Fig. 96.—*Sarcomenia dasyoides*: Two specimens.

2. Branches alternate *S. Victoriae*
(Harv.) J. Agardh.

3. Branches stout below, penicillate above.
Fruiting branches secund *S. tenera* (Harv.)
J. Agardh.

Investigator Strait.

4. Branches stout below, forming corymbs
above *S. corymbosa*
J. Agardh.

S. tenera spreads from Western Australia to Victoria and has been found in South Australia. The other two species so far only known from Victoria.

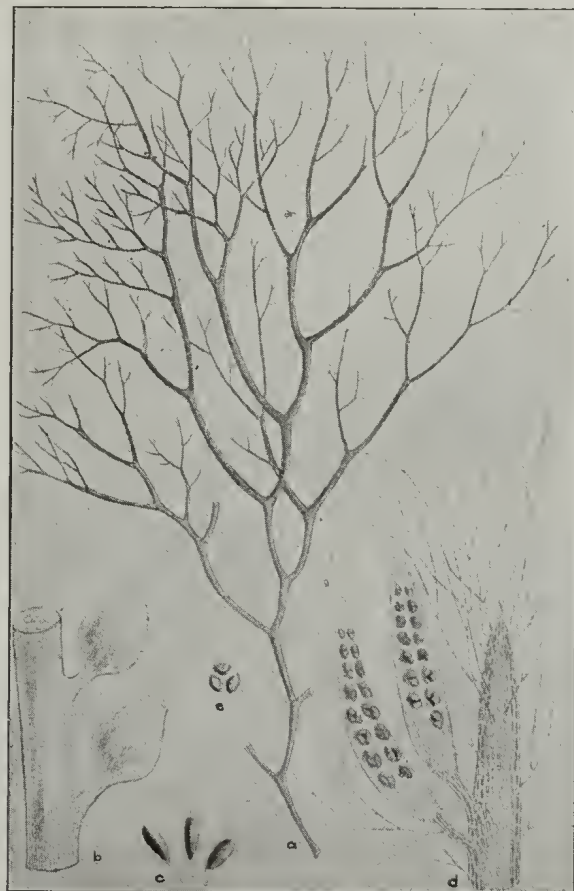
Fig. 97.—*Sarcomenia Victoriae*.Fig. 98.—*Sarcomenia corymbosa*.

Fig. 99.—*Sarcomenia tenera*: a, plant; b, fragment of a branch, bearing ceramidia; c, spores; d, apex of a branch, with stichidia and ramelli; e, a tetraspore. (After Harvey.)

C.—Corticate, tall to 60 cm., flat and to an inch wide. Pinnate, the pinnae springing from within the margin.

Sarcomenia delesserioides Sonder.

Fronds tufted, 30 cm. to 90 cm. high, originating in an undivided lanceolate leaf-like flat axis, of varying length, and breadth from 4 mm. to 4 cm., with an evident midrib. This primary frond emits from points within the margin numerous opposite pairs of similar fronds, the primary pinnae, these emitting similar secondary pinnae. Sometimes the ends of the branches end in long clasping tendrils. Pedicellate cystocarps scattered over both primary and secondary pinnae. Stichidia scattered, lanceolate, bearing a double row of tetrasporangia. Colour when growing a fawn-grey, rapidly changing in air or fresh water to a bright rosy-red. Substance easily dissolved.

Western Australia, South Australia (Cape Spencer), Victoria to Western Port.



Fig. 100.—*Sarcomenia delesserioides*: a, variety , *latifolia*; b, variety , passing into variety 8; c, section, to show the cellular structure; d, a ceramidium; e, spores from the same; f, a stichidium; g, a tetraspore. (After Harvey.)

SONDERELLA Schmitz.

The one species.

Sonderella linearis (Harv.) Schmitz.

Holdfast a minute disc. Fronds 6 cm. to 20 cm. high, 2 mm. to 3 mm. in breadth, linear, obtuse, proliferous from the slender midrib in leaflets of similar form. The lamina is composed of hexagonal cells, set in obliquely transverse lines. Cystocarps and tetrasporangia borne on small sporophylls springing from the midrib, the cystocarps single, sessile on the midrib, the tetrasporangia in a single row on each side of the midrib. Colour brownish-red, darker on drying. Substance membranaeous, so that the plants do not adhere to the mounting paper.

South Australia (Eastern Bays) and Victoria.

CLAUDEA Lamouroux.

Claudea elegans Lamouroux.

Frond stipitate, stipe stout filiform, merging into the marginal rib of a unilateral flat open network. The main frond 30 cm. to 45 cm. high is beautifully curved, bearing the reticulated fringe on the convex side of the



Fig. 101.—*Claudea elegans*: a, portion of a frond; b, portion of a branch bearing ceramidia; c, a metamorphosed leaflet bearing a ceramidium; d, spores from the same; e, portion of the network bearing stichidia; f, stichidium, between sections of two bars; g, tetraspores. (After Harvey.)

marginal rib, and from the concave side spring at intervals similar curved branches or leaflets bearing a network on the convex side. These again may give off similar secondary leaflets. The framework of the network consists of firm parallel ribs which pass at right angles to the marginal rib to project beyond the free margin of the network, something like the teeth of a fine comb or the vanes of a feather. These ribs are joined by short slender bars running at right angles to the ribs, from each to the next. These secondary bars are united similarly by a third series at right angles to the secondary and parallel to the primary ribs.

The cystocarps are formed from the cross bars of the first or second order, which become transformed into a winged, clavate, mucronate pedicel, the cystocarp being formed near the summit. The stichidia are formed out of the secondary bars, and are elliptical, containing transverse rows of tetrasporangia. Colour dull-red when growing, becoming rose-coloured on drying. Substance firm, somewhat cartilaginous.

Claudea elegans has been dredged in 5 fathoms to 10 fathoms of water at Fremantle, in Western Port, and the Tamar estuary. Svedelius records it, together with other typical Australian algae, from the North Arabian Sea, off the coast of India. Truly a remarkable distribution.

BONNEMAISONIACEAE (Trev.) Sohn.

Erect plants with decompound branched axis, growing in one plane. branches often pectinate with ramuli.

SYNOPSIS OF THE GENERA.

- A.—Apical cell transversely articulate. Frond flat or two-edged, with midrib and opposite transverse nerves from midrib to margin *Leptophyllis*
J. Agardh.
- B.—Apical cell obliquely distichously articulate.
No transverse nerves.
1. Frond flat, midribbed. Cystocarps globose, stipitate, borne on the margin of the frond *Ptilonia*
J. Agardh.
 2. Frond narrow, two-edged, midribbed below alternately pectinate-serrate. Central tube in the axis. Cystocarps ovoid, sessile, lying obliquely on the upper face of the segment near the apex *Delisea*
Lamouroux.
 3. Frond filiform, not compressed. Central tube in the axis. Oppositely ciliate-plumose. Cystocarps stipitate, replacing simple pinnules *Bonnemaisonia*
C. Agardh.

4. Frond filiform, not compressed. Central tube in the axis. Pectinate-ciliate, much branched, above penicillate. Cystocarps globose, stipitate, replacing simple cilia or pinnules *Asparagopsis* Montagne.

LEPTOPHYLLIS J. Agardh.

Frond membranous, flat, thin, linear, distichously pinnatifid, formed of large polygonal granuliferous internal cells, corticated externally by minute-coloured cellules. Cystocarps ovoid, terminating shortened pinnules, containing a tuft of pear-shaped spores. Sori oblong or linear lying within the margin; tetrasporangia very numerous, rounded, cruciately (not triangularly as Harvey) divided.

Leptophyllis conferta (R. Br.) J. Agardh.

The single species. Height 10 cm. to 15 cm., width 2 mm. to 4 mm. Margin serrulate. Colour rose-red.

Victoria and Tasmania.

PTILONIA J. Agardh.

Frond linear, flat, or two-edged, decompound-pinnate, serrate-dentate, subcostate. Three strata of cells, the inner of longitudinal branching threads, the intermediate of angular-roundish cells, the cortical of smaller, rounded cells. Cystocarps globose, stipitate, borne on the margin of the frond. Sori of tetrasporangia irregular, lying within the margin as in *Leptophyllis*. (I have only seen the sori in one specimen. The tetrasporangia seemed to me to be in tetrads but they were not clearly divided. This is the only record of the sori of *Ptilonia*.)

Ptilonia australasica Harvey.

Height 10 cm. to 20 cm., width 8 mm. to 16 mm. Dark red-purple.
 South Australia (Eastern Bays), Victoria, Tasmania.

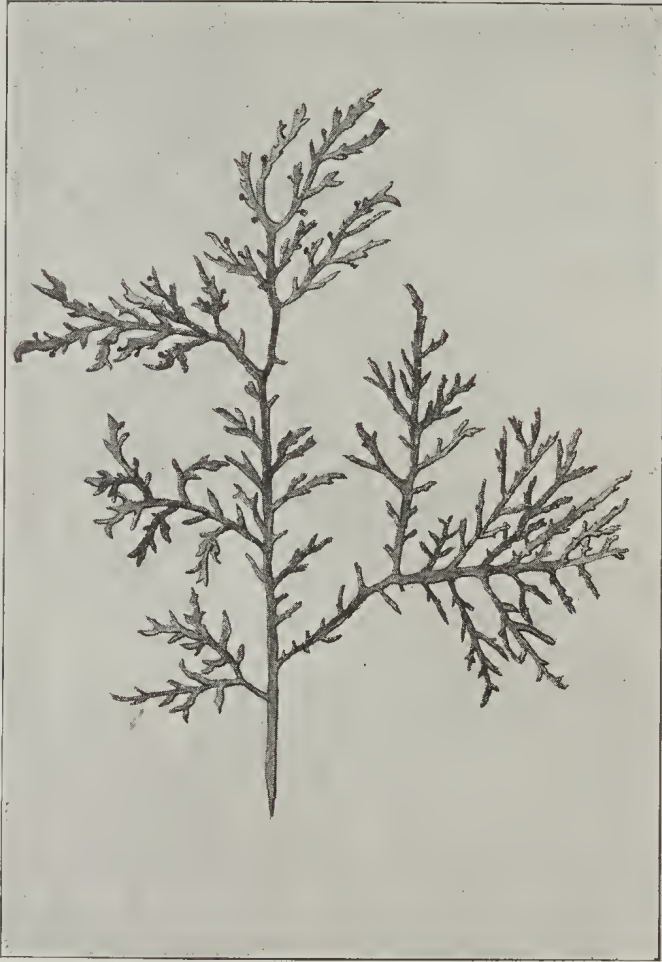


Fig. 102.—*Ptilonia australasica*: Plant with cystocarps.

DELISEA Lamouroux.

Frond filiform but compressed or two-edged, continuous solid traversed by a central tube, compound pinnate, the branches pectinate with subulate pinnules. Cystocarps ovoid toward the apex of the branch. Tetrasporangia in warts on both faces surrounding the apices, zonately divided.

1. Cystocarps solitary or binate, seated in the sinus
 of the marginal cilia. Cilia simple *D. elegans* (Ag.)
 Montagne.

2. Very much resembling *D. elegans*, but the cilia are themselves again pectinate *D. hypneoides*
Harvey.

South Australia (Investigator Strait, Eastern Bays).

3. Cystocarps terminating the ramuli. A stouter plant and a deeper red than the two former .. *D. pulchra*
(Grev.) Montagne.

South Australia (Eastern Bays).

All three are tall, 30 cm. to 60 cm.; all are excessively and elegantly branched. All extend along the southern coast of Australia.

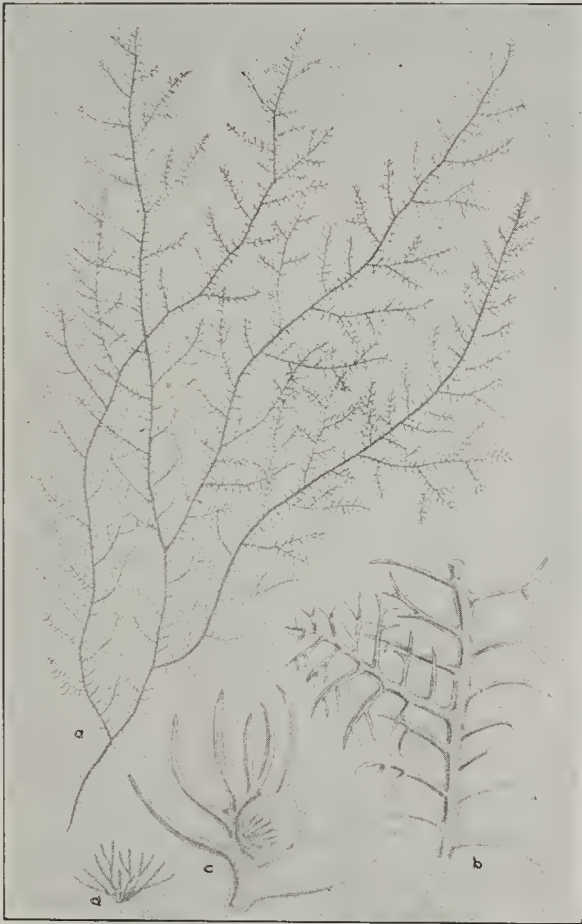


Fig. 103.—*Delisea hypneoides*: a, plant; b, small portion of a branch, with ramulus; c, apex of a fruiting branch, with its conceptacle; d, some of the barren filaments (paranemata) from the conceptacle. (After Harvey.)

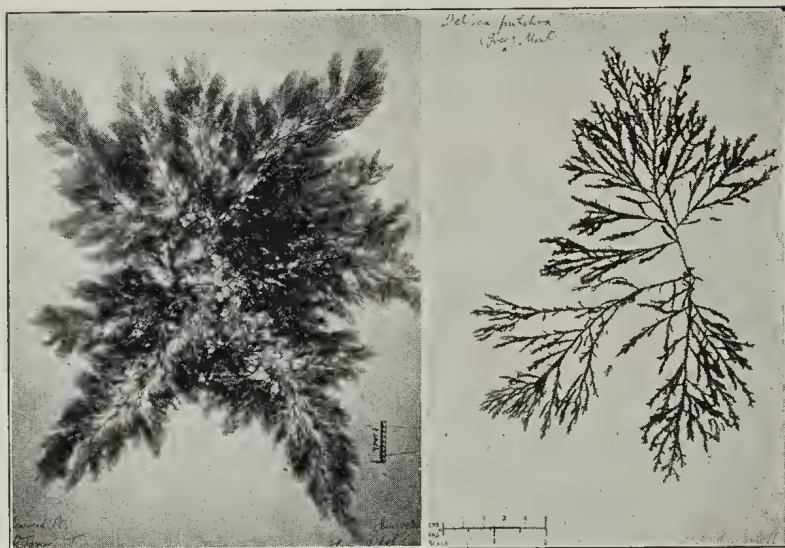
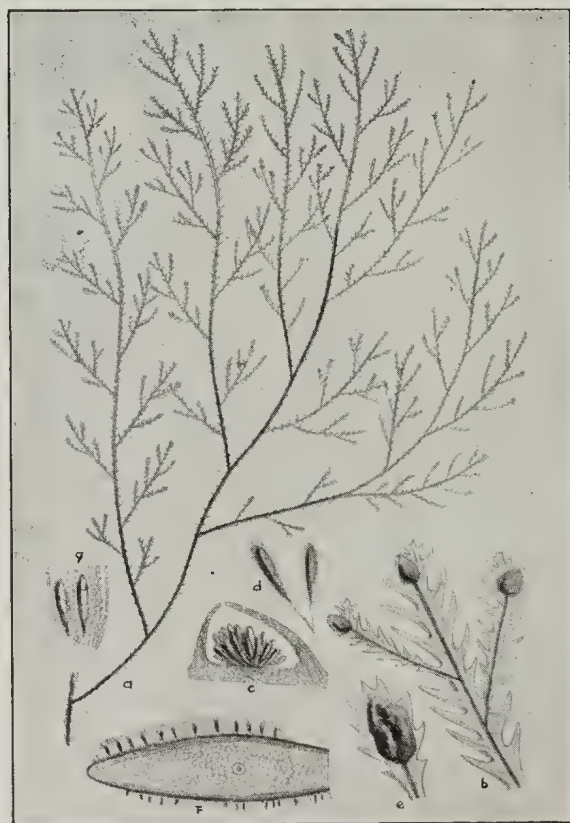
Fig. 104.—*Delisea elegans*.Fig. 105.—*Delisea pulchra*.

Fig. 106.—*Delisea pulchra*: a, plant; b, pinnules with conceptacles at their apices; c, vertical section of a conceptacle; d, spores from the same; e, apex of a ramulus, with a wart (nemathecium); f, cross-section through the same, showing the structure of the frond, and the external growth of the wart; g, tetraspores and paranemata from the same. (After Harvey.)

BONNEMAISONIA C. Agardh.

Frond filiform, compressed, decomposed-pinnate, oppositely ciliate-plumose. A central tube, with slender branches passing among the large rounded cells of the intermediate layer, and a cortical layer of minute cellules. Cystocarps pedicellate, transformed from a ramulus. Tetrasporangia unknown.

Bonnemaisonia asparagoides (Woodw.) C. Agardh.

Frond to 30 cm. high, below about 2 mm. thick. Colour rosy.

The species (and genus) has only been observed in Australia from the specimens collected by Miss Davey in Investigator Strait, and recognized and determined by Reinbold.

ASPARAGOPSIS Montagne.

Frond filiform, above penicillate, branching, thyrsoïd-paniculate, the ramuli pinnulate, opposite with delicate cilia. A central slender tube surrounded by large thin cells, and a cortex of minute radiating coloured cells. Cystocarps globose pedicellate, formed from a pinnule. Tetrasporangia not known.

There are two South Australian species, both about 25 cm. high.

Asparagopsis armata Harvey.

Fronds springing from creeping rhizomes, alternately branched, main divisions and lesser branches clothed nearly to the base with short penicillate branchlets, and each armed below with two or three long, naked, patent



Fig. 107.—*Asparagopsis armata*: a, plant; b, base of one of the penicillate branchlets, with a ceramidium and one of the pinnules; c, spores. (After Harvey.)

or arching branchlets, set with alternate reflexed prickles. Svedelius found that these serve as a means of vegetative reproduction, and by becoming attached to steamers this Australian alga has been carried to the coast of France and Algiers, and has grown in the last ten years into extensive colonies. Ultimate ramelli very fine, inarticulate. Cystocarps globose, on short or long peduncles, generally two or three together near the base of the penicillate branchlets. Colour pale or bright purplish-red, sometimes fading to yellow. Substance soft and flaccid.

Southern Anstralia, Tasmania, New Zealand. Collected in South Australia from Encounter Bay, Investigator Strait, Eastern Bays.

Asparagopsis Sanfordiana Harvey.

Fronds erect, springing from tangled creeping rhizomes, about 2 mm. thick below, attenuated upwards. Fronds naked for half or three-fourths their length, densely clothed above with penicillate-multifid branchlets. Branchlets 1 cm. to 3 cm. long, inserted on all sides, many times pinnated, and finally capillary. Ultimate ramelli filiform, attenuated, sub-compressed, curved inwards and coated with polygonal irregular cellules. Stem inarticulate, consisting of a slender articulated single-tubed axis and a cortical stratum of large, oblong cells, with a layer of minute coloured cells externally. Cystocarps formed at the apex of abbreviated, transformed ramuli, containing a large tuft of spores. Colour a dark brownish-red.

Western Australia, South Australia (Kangaroo Island).

Family RHODOMELACEAE (Reichenbach) Harvey.

CONSPECTUS OF THE SUBFAMILIES.

- a. The whole frond a monopodium, *i.e.*, the primary segments of the frond proceeding from joints arising from the same apical cell.
- b. Apical cell immersed in a depression. Central axis very imperfectly clothed in a ring of pericentral siphons. Tetrasporangia nidulating immediately below the superficial stratum of cells *Laurencieae*.
- bb. Apical cell not immersed in a depression (except in some *Chondriæ*). Central axis clothed in a perfect ring of pericentral siphons. Tetrasporangia formed from a cell adjacent to a pericentral cell.
- c. Pericentral cells almost always undivided.
- d. Fronds radiately constructed.
- e. Frond destitute of persistent lateral mono-siphonous filaments.
- f. Tetrasporangia not disposed in the spiral line; in twos or threes in each segment. Pericentral cells five, conspicuous, corticated *Chondrieae*.
- ff. Tetrasporangia, one in each segment disposed in a straight or spiral line. Tetrasporangiferous branches like the sterile, or differing from them and forming stichidia.

- g. Fronds erect or decumbent at the base, terete or compressed, branching in all directions (with 4 to 20 pericentral siphons) or corticated (with 4 or 6 to 10, not five siphons). Tetrasporangia in a spiral line *Polysiphonieae.*
- gg. Fronds erect or decumbent at the base, terete or compressed, distichously branched. Siphons 4 to 12. Sporangia in a straight line . . . *Pterosiphonieae.*
- ee. Frond adorned with persistent lateral mono-siphonous filaments.
Pericentral siphons 4 to 8, naked or corticated. Sporangia verticillate in each segment, or single or twinned . . . *Lophothallicae.*
- dd. Fronds creeping or erect, endowed with dorso-ventral structure.
 - h. Tetrasporangia single in each segment.
 - i. Frond terete or compressed, branched with pairs of marginal alternating branches, one of each pair short, the other long *Polyzonieae.*
 - ii. Frond not with paired branches *Herposiphonieae.*
 - hh. Tetrasporangia two in each segment, thus forming two longitudinal series.
Frond various, caespituli of filaments (when present) and fruits arranged in a longitudinal series in the dorsal region of the frond *Rytiphloeae.*
- cc. Pericentral cells alternately divided by transverse septa (sometimes also longitudinal) so that the central axis is quickly obscured.
Sporangia spirally disposed, single in each segment. Pericentral cells at first four . . . *Heterocladieae.*
- aa. The whole plant a sympodium.
Frond usually terete, laterally or sub-dichotomously branched. Axis with conspicuous siphons, naked or corticated. Sporangia arranged in definitely constituted proper stichidia, often verticillately grouped *Dasyeae.*

Subfamily Laurencieae (Harvey) Zanardini.

LAURENCIA Lamouroux.

Frond erect, terete and branched on all sides, or flattened, branching distichously; a proper central axis very little conspicuous can be distinguished toward the apex of the frond, with two strata, an interior of oblong-angulate cells, the central longer, smaller, shorter toward the circumference of the frond; and an exterior of rounded-angular cells disposed in a simple series. Cystocarps ovate-spherical, transformed out of a ramulus, containing within a cellular pericarp open by a carpostomium, pear-shaped carpospores in the terminal joints of threads radiating from a central placenta. Tetrasporangia aggregated without order in a transverse zone, below the cortical cells of ramuli. Antheridia numerous included within a salver-shaped receptacle. The substance fleshy, cartilaginous.

I.—Fronds terete.

A.—Fertile superior ramuli diverse from lower and sterile ramuli.

Laurencia heteroclada Harvey.

Densely tufted, springing from creeping shoots; frond livid-purple, terete, tough, 10 cm. to 20 cm. high. The lower sterile fronds closely set with lateral, often secund ramuli very straight and erect, filiform, with narrow axils. The fertile frond stipitate, with panicle or dendroid branches, dividing into many sub-patent secondary branches, which are set throughout with short, multifid, corymbose ramuli. Cystocarps ovate, sessile, borne on otherwise naked ultimate ramuli. Tetrasporangia apical in short, swollen ramuli.

Covering the exposed edges of reefs at low water mark, spreading continuously over wide spaces.

Western Australia, South Australia, Victoria.

B.—Fertile and sterile fronds similar in form.

a. Filiform.

Laurencia filiformis (C. Ag.) Montagne.

Very slender, partially dichotomous, with elongate trailing branches and slim ramuli. Height 4 cm. to 15 cm. Colour rosy. Substance fleshy-membranaceous.

Western Australia, South Australia (Eastern Bays), Tasmania.

Laurencia Forsteri (Mertens) Greville.

Stouter than *L. filiformis* with clavate filiform branches. Height 5 cm. to 15 cm., about 1 mm. thick. Colour rosy-purple, fading to yellow. Often epiphytic on *Cymodocea*.

Common on all the south coast of Australia and Tasmania. South Australia (Encounter Bay, Holdfast Bay, Investigator Strait, Eastern Bays).

Laurencia Casuarina J. Agardh.

Ultra-setaceous, erect, with verticils of short ramuli. About 4 cm. to 20 cm. high.

South Australia (Port Elliot).



Fig. 108.—*Laurencia Forsteri*.



Fig. 109.—*Laurencia botryoides*: a, plant; b, part of a pinnule with "grape-clusters"; c, tetraspore; d, ramulus, bearing male saucers; e, flocci from the same. (After Harvey.)

Laurencia majuscula (Harvey) Lucas.

An arborescent species, of a rich red-purple colour, growing to the height of 30 cm. or more, very densely compound pinnate, with short crowded branches and branchlets.

Western Australia, South Australia, Victoria to North Queensland, Lord Howe Island.

Laurencia tasmanica Hooker and Harvey.

Frond arborescent, to 30 cm. or more high, somewhat compressed, sub-regularly oppositely branched. Colour livid-purple.

South Australia (Investigator Strait, Port Noarlunga), Victoria, Tasmania.

Laurencia botryoides Gaill.

Frond distichously pinnate, with a flexuous excurrent rachis; pinnae alternate, patent, once or twice compound; pinnules conical, obtuse, densely tuberculated, the warts globose. Colour dull-purple.

South Australia (Kangaroo Island), Tasmania.

II.—Frond compressed.

Laurencia elata (C. Ag.) Harvey.

Frond 30 cm. to 45 cm. high, 2 mm. diameter, compressed or flat, many times pinnate. Primary branches two to three times pinnate, the lower



Fig. 110.—*Laurencia elata*: a, branch; b, apex of a fertile ramulus, with cystocarps; c, tuft of spores. (b and c, after Harvey.)

pinnae longest, all the divisions alternate and erecto-patent. Pinnules $\frac{1}{2}$ cm. to $1\frac{1}{2}$ cm. long, linear, truncate. Colour a dark-red. Cystocarps terminating the pinnules, ovate.

Western Australia, South Australia (Encounter Bay, Investigator Strait), Victoria, Tasmania.

CORYNECLADIA J. Agardh.

Fronds terete, sub-caulescent; ramuli clavate, vaguely or sub-umbellately disposed, cellular, of three strata; inner of sub-stellate anastomosing cells, intermediate of round, external of small cells disposed in simple series. Cystocarps ovate, transformed from ramuli, with a cellular pericarp and osteole. Tetrasporangia in apices of ramuli, aggregated in a transverse zone, formed in infra cortical cells; triangularly divided.

Corynecladia clavata (Sond.) J. Agardh.

Fronds 10 cm. to 20 cm. long, 2 mm. thick, subpinnately branched; ramuli sparsely fasciculate and branches often densely ramulose; ramuli cylindrical-clavate, obtuse. Colour blood-red, substance firm.

Western Australia, South Australia (LeFevre Peninsula).

Corynecladia umbellata J. Ag.

Fronds 7 cm. to 10 cm. long, sub-umbellate, branches cylindrical-clavate; terminal ramuli simple, clavate, obtuse; articulate in young parts.

Western Australia, South Australia (Eastern Bays).

JANCZEWSKIA Solms-Laubach.

Fronds parasitic, minute, cushion-shaped, surface verrucose; rhizoids penetrating host plant. Cystocarps minute, more or less grouped. Tetrasporangia triangularly divided.

Janczewska tasmanica Falkenberg.

Frond large for the genus, with many elongate tubercles conjoining together.

South Australia (Investigator Strait), Tasmania. Occurring on frond of *Laurencias*.

Subfamily Chondrieae (Kützinger) Schmitz.

KEY TO THE GENERA.

Fronds erect, often large and conspicuous, terete or plane, becoming excessively branched.

a. Sterile segments by no means of lax context, polysiphonous axis always evident.

b. Pericentral siphons 5, large, always corticated with minute slender cells in 1 to 2 strata.

Sporangia not in a longitudinal line, crookedly

disposed *Cladurus* Falk.

- bb. Pericentral siphons 5, corticated with large cells gradually decreasing in size outwards.
- c. Ramuli dwarf, ecorticate to axils of most larger branches, densely caespitose.
 Ramuli pointed, spirally disposed *Maschalostroma*
 Schmitz.
- cc. Lateral ramuli short, spine-like, spirally disposed.
 Sporangia nidulating in hollows of short ramuli *Acanthophora*
 Lamour.
- aa. Segments cylindrical or plane, destitute of spines, sterile parts extensive, lax, sometimes full of hyphae.
- d. Axis polysiphonous, sterile parts lax for a long time, or rather tubulose-hollow, median axis giving off verticillate branches.
- e. Segments terete, mostly articulate-constricted, branching on all sides (apparently verticillate) *Coeloclonium*
 J. Ag.
- ee. Segments terete or compressed-terete, stipitate, slightly contracted *Dolichoscelis*
 J. Ag.
- dd. Axis polysiphonous, sterile parts lax but soon becoming compact, always packed with percurrent hyphae. Segments cylindrical or complanate, branching on all sides, distichous or plane *Chondria* (Ag.)
 Harv.

CLADURUS Falkenberg.

Frond compressed or terete, dendroid, pinnate, transversely striate, corticated; the axis articulated, composed of a circle of large oblong cells surrounding a central cell; the periphery of several rows of small, angular (mostly) coloured cells. Cystocarps ovate, containing a tuft of pear-shaped spores. Stichidea containing tripartite tetrasporangia.

Cladurus elatus (Sond.) Falkenberg.

= *Rytiphœa elata* Harvey.

Holdfast or attachment a large bulbous disc. Frond 60 cm. or more in height, the stem and larger branches 4 mm. to 6 mm. in diameter, the secondary branches 1 mm. to 2 mm., excessively branched and bushy or dendroid. Stem simple or forked, or irregularly divided; its divisions supporting decompound di-trichotomous, or alternately divided heads of branches. Lateral branches 15 cm. to 20 cm. long, sometimes laxly, sometimes very densely ramuliferous; the ramuli either scattered or fasciculate,

filiform, attenuated at base, tapering and acute, spreading or divaricate. All parts of the frond are opaque, coated with thick layers of minute cellules. Ceramidia ovate, solitary, scattered, on longish pedicels, rarely sessile, opaque and thick-walled. Stichidia shortly lanceolate or spindle-shaped, in dense tufts on the sides of the ramuli and lesser branches, containing a

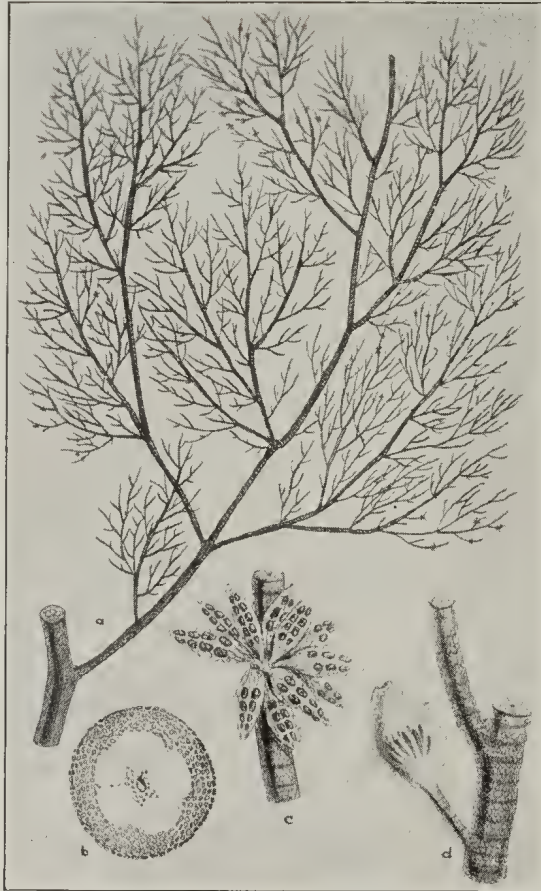


Fig. 111.—*Cladurus elatus*: a, part of a large frond; b, section of a branch; c, tuft of stichidia; d, a ceramidium. (After Harvey.)

double row of tetrasporangia. Colour a very dark brownish-purple, becoming black in drying. Substance tough and rigid. Does not adhere to paper well in pressing, unless very young.

South Australia (Eastern Bays), Western Australia, Victoria, and Tasmania.

MASCHALOSTROMA Schmitz.

Frond filiform or compressed, cartilaginous, pinnately or irregularly decompose, opaque, coated with small polygonal, irregular cellules, axis articulated, polysiphonous. Ramuli alternate subulate, acute, transversely striate. Cystocarps containing within a membranous pericarp a

tuft of pear-shaped spores. Tetraspores tripartite, lodged in lanceolate stichidia.

Maschalostroma fastigiata Falkenberg.

= *Alsidium comosum* Harvey.

Stem from 40 cm. to 50 cm. long, 3 mm. to 4 mm. in diameter below, tapering upwards to a fine point, simple and closely set throughout the greater part of its length with lateral branches spreading every way.



Fig. 112.—*Maschalostroma fastigiata*: a, plant; b, small portion of a ramulus, bearing articulated ramella; c, cross-section of a branch. (After Harvey.)

Branches 10 cm. to 12 cm. long, virgate, tapering to a slender point, simple, but set with closely placed, filiform, simple ramuli. Ramuli setaceous, about 3 cm. long, clothed with byssoid ramelli. Ramelli 4 mm. to 6 mm. long, extremely soft and delicate, quite simple or forked near the base, articulated; the articulations cylindrical, many times longer than broad. A cross section of the inarticulate branches shows a single row of coloured, peripheric cells, surrounding a cellular body, in which the articulated axis

is not very obvious. Colour a full rosy-crimson, discharged in fresh water, becoming a brown-red in drying. Substance extremely soft and subgelatinous.

South Australia (Encounter Bay, Streaky Bay, Eastern Bays), Victoria, Western Australia (Vasse).

ACANTHOPHORA Lamouroux.

Fronds erect, terete, forming lax intricate tufts, filiform, vaguely branched; the branches alternate or secund, very patent, elongate, distant, but little divided, gradually attenuate, furnished along their whole extent with minute, tooth-like, alternate, spirally inserted ramuli, one to two lines apart, cleft at the apex into 3-5 short spine-like teeth. Substance cartilaginous. No outward appearances of any joints, but internal. Structure of the frond similar to *Maschalostroma*.

Acanthophora dendroides Harvey.

Frond bushy, ramuli irregular, pyramidal, setaceous, the ramelli above the base more setaceous. The bristles in the adult plant spreading, subulate. Stichidia set regularly on the setaceous rachis, subulate, in the apices of the almost denuded ramelli.

Western Australia (Rottnest Island), Indian Ocean.

CÆLOCLONIUM J. Agardh.

Frond filiform, cartilaginous, dendroid, opaque, coated with polygonal, irregularly placed cells. Axis articulated, polysiphonous. Ramuli claviform, much constricted at their insertion. Cystocarps ovate. Tetrasporangia tripartite, formed irregularly in the clavate ramuli.

Cæloconium verticillatum (Harv.) J. Agardh.

= *Chondria verticillata* Harvey.

Attachment discoid. Stems densely tufted, 7 cm. to 13 cm. long, nearly 2 mm. in diameter, simple or umbellately compounded, each partial umbel of 4-5 rays or more, round the base of which a whorl of fasciated ramuli are frequently developed. The secondary branches are long and virgate, simple or umbellately compounded, and are either whorled at short intervals with simple, club-shaped ramuli, or set closely with such ramuli. Ramuli 6 mm. to 12 mm. long, nearly 2 mm. in diameter, strongly constricted at base, very obtuse, patent. Cystocarps ovate, sessile on the ramuli. Tetrasporangia either scattered, or brought together in an irregular sorus, near the middle of the ramulus. Colour a dull purplish-brown becoming darker in drying. Substance succulent.

South Australia (Investigator Strait, Eastern Bays), Western Australia, Victoria (Port Fairy), Tasmania (Georgetown).



Fig. 113.—*Coeloclonium verticillatum*; a, plant; b, a ceramidium; c, spores from the same; d, two ramuli, with tetraspores; e, tetraspores. (After Harvey.)

* *Cœloclonium umbellulum* (Harv.) Reinbold.

= *Chondria umbellula* Harvey.

Attachment a disc. Frond short, dwarfed, 2 cm. to 7 cm. long, sometimes solitary, sometimes in groups, often epiphytic, two or three times umbellately or verticillately branched; ramuli obovate, clavate, joined very delicately. Cystocarps arranged on the middle of the ramelli singly, sessile,

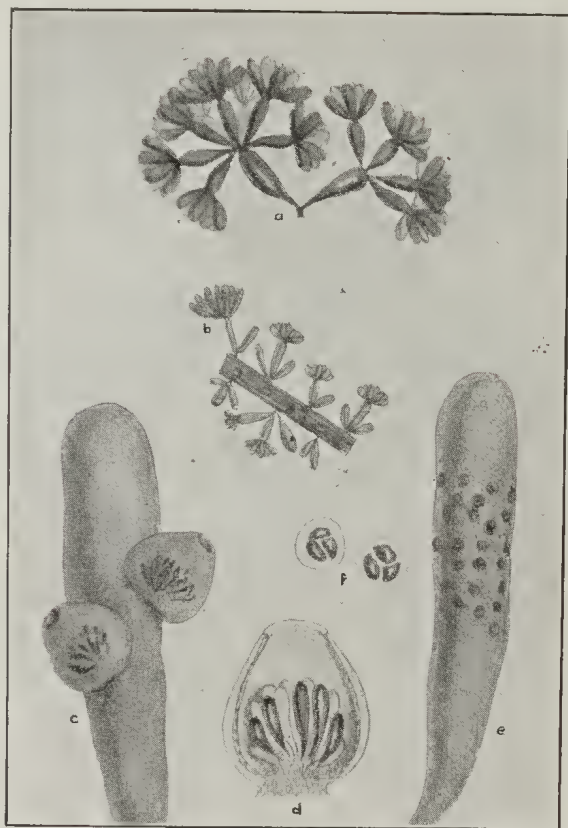


Fig. 114.—*Cœloclonium umbellulum*: *a* and *b*, plants; *c*, apex of a ramulus, with conceptacles; *d*, vertical section of a conceptacle; *e*, a ramulus, with tetraspores; *f*, tetraspores. (After Harvey.)

ovate, constricted at the base. Tetrasporangia sparsely scattered over the upper part of the ramelli. Colour purplish, changing more or less when dry. Substance soft flaccid, succulent. Adheres to paper.

South Australia (Investigator Strait, Eastern Bays), Western Australia (Rottnest and Garden Islands).

Cœloclonium opuntiioides (Harv.) J. Agardh.

= *Chondria opuntiioides* Harvey.

Elongated, irregular, verticillately branched, the ramuli of the verticils often elongate, regular, more or less moniliform, simple or dichotomous; articulations delicately joined, lower ones cylindrical-elongate, the upper

ones obovate. Cystocarps sessile at the apices of the ramelli. Tetrasporangia on the upper parts of the shortly vesiculose lateral ramelli. Colour purplish, adheres firmly to paper.

South Australia (Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays) West and South Coasts generally, common.

Cæloconium incrassatum J. Agardh.

Fronde continuously branching outwards, elongate, irregularly pinnate; stem and principal ramuli thick attenuated, obtuse; ramuli spreading in all directions, singly or soon dividing; lesser branches whorled round the principal ones in fascicles, subcollaterally; ramelli subclavate. Cystocarps sessile, arranged along the ramuli, urceolate, globose, prominent above the ramelli. Tetrasporangia mostly on the upper part of the ramelli. Substance firm, gelatinous, adheres to paper. This species hardly differs from *C. verticillata*.

South Australia (Eastern Bays) and Tasmania.

DOLICHOSCELIS J. Agardh.

Fronde stipitate, terete, or almost terete, with ramuli branching in every direction, subdistichous, or corymbose, abundant; central axis surrounded by many irregular cellules, the outer layer of cells angularly rounded, arranged in a few rows. Tetrasporangia forming a circle a little below the apices, triangularly divided.

Dolichoscelis clavifera J. Agardh.

Fronde terete, filiform, ramuli branching, more or less decomposite, adult ramuli almost cylindrical, filiform; branching into similar dispersed ramelli; some simple, subclavate, some more decomposite; subverticillate. Tetrasporangia forming a circle a little below the apices, triangularly divided.

South Australia (Spencer Gulf, Encounter Bay), Tasmania.

Dolichoscelis disticha J. Agardh.

Fronde subterete, stem bare below, above with ramelli branching from near the margin, subdistichous; the upper ones simple, subclavate, obtuse; lower ones irregular, sending out another row of ramelli.

South Australia (Port Elliot).

Dolichoscelis gracilipes J. Agardh.

Fronde terete both above and below, broad, spreading; ramuli ovate, visibly ribbed; upper part terete, with filiform ramuli branching, forming fertile terminal corymbs. Cystocarps singly below the apices of the ramelli, obovate, globose, subpedicellate.

South Australia (Port Elliot).

CHONDRIA Agardh.

Fronde slightly terete, compressed, irregular; branches virgate, constricted at the base, polysiphonous in the cortex, five cellules placed at equal distances, circling the axis, with smaller cellules in the cortex. Cystocarps at the junction of the upper ramelli. Tetrasporangia developed in

the scarcely changed ramelli, in the cells surrounding the central axis, triangularly divided. Antheridia ovate, emerging from the superficial depressions around the apices of the ramelli, within a thin membrane formed of translucent cellules, carrying many small granules. Colour purplish-brown, gelatinous.

Chondria tenuissima (G. et W.) C. Agardh.

Fronds densely tufted, 12 cm. to 30 cm. long, about 1 mm. in diameter below, attenuated upwards. Stem simple or divided, bearing closely-set, slender, alternate, virgate, erecto-patent, undivided branches, often bearing a similar set. Branches slender, tapering to base and apex, more or less densely clothed with setaceous ramuli; ramuli simple, 4 mm. to 8 mm. long,



Fig. 115.—*Chondria fusifolia*.

Fig. 116.—*Chondria tenuissima*.

tapering to base and apex, irregularly inserted. Cystocarps ovate, subsessile, borne profusely on the sides of the ramuli. Tetraspores contained in the ramuli, globose, scattered. Stem consists of six large cells surrounding a central one, with a wide cortex of smaller cells. Substance tender, adhering to paper. Colour pale pinkish-purple, fading to yellow.

South Australia (Investigator Strait), Tasmania (Georgetown), Mediterranean and Atlantic.

Chondria fusifolia Hooker f.

Frond 20 cm. to 25 cm. high, very irregular, pyramidal, with long spreading ramuli, virgate; ramelli widely spread, fusiform, lanceolate. Stichidia linear, carrying tetrasporangia at the base.

Tasmania, Southern Australia.

Chondria lanceolata Harvey.

Fronds pyramidal, ramuli irregularly virgate; ramelli very widely spreading, fusiform, tufted at the ends. Stichidia above, pedicellate, clavate-cylindrical, depressed, in acuminate tufts, carrying tetraspores in the depressions in long rows. Cystocarps laterally in the ramelli, shortly pedicellate, almost globose.

Western Australia (Rottnest Island).



Fig. 117.—*Chondria lanceolata*: a, a tetrasporic plant; b, a cystocarpic plant; c, ramuli, bearing cystocarps; d, a cluster of spores, from the same; e, ramuli, bearing tetraspores; f, a tetraspore. (After Harvey.)

Chondria arborescens J. Agardh.

Frond robust, stem below almost naked; the ramuli and ramelli are often in pairs and almost cylindrical. Stichidia very long, fusiform and exceedingly tufted, carrying tetrasporangia at the base in the young plants; in the fully grown plant, the tetrasporangia are carried in long rows. Cystocarps pedicellate, very scattered on the ramelli, ovate-globose. Colour dark-red, drying nearly black.

Victoria (Port Phillip).

Chondria foliifera (J. Ag.) Falkenberg.

Frond 25 cm. to 40 cm. high, almost pyramidal; ramuli almost regular, alternately pinnate; pinnae spreading from the rachis, linear-lanceolate, aneipitous, singly or covered with another row of pinnellae, all very fusiform, the last carrying fruit. Tetrasporangia in the upper part of the lesser pinnulae. Cystocarps on the edges of the pinnulae, singly or in groups.

South Coast of Australia.

Chondria ovalifolia J. Agardh.

Fronds 15 cm. to 25 cm. long, aneipitous, spreading widely and evenly from the edge of the stem; sometimes alternate, at other times almost opposite, branching off close to the main stem; smaller ramelli oval, and larger ones ovate-oblong, all very obtuse and constricted at the base almost into petioles; cortical cellules ovate-oblong. Colour purplish-red. Adheres to paper closely.

Victoria (Port Philip).

Chondria Curdieana Harvey.

Fronds paniculate, irregularly pinnately branched, ramuli close together, fasciated; the ramelli pyriform, clavate, depressed and tufted above, curving to the apices; numerous ramelli emitted from the inner side of the curve, and forming a second set of ramelli. Stichidia regular, carrying tetraspores on the tufted upper parts of the adult frond. Substance cartilaginous, adheres to paper.

South Coast of Australia.

Chondria succulenta (J. Ag.) Falkenberg.

Frond 15 cm. to 20 cm. long, terete, sometimes paniculate, at other times fasciated, ramuli and ramelli rising from the cylindrical rachis singly and very attenuated, the younger ramelli elliptical, adult ramuli cylindrical-oblong; slightly tufted. Stichidia tufted and carrying tetrasporangia, with prominent obtuse apices. Cystocarps large, almost globose, shortly pedicellate, carried in the apices of the ramelli. Substance gelatinous, adheres to paper.

South Australia (Eastern Bays).

Chondria debilis Harvey.

Frond 8 cm. to 14 cm. long, very small, widely dichotomous, flexuous, the ramuli alternate, spreading filiform, clavate at the apices, the ramelli spreading and clavate. Tetrasporangia prominent, clustered in the apices of the ramelli. Substance in young plants gelatinous, in older plants firmer.

West Australia (King George Sound), Tasmania (Georgetown).

Subfamily Polysiphonieae (Kutzing) Schmitz and Falkenberg.

KEY TO THE GENERA.

- a. Lateral ramuli of vegetative branches sometimes abbreviated, spiral or irregular. Tetrasporangia in upper vegetative ramuli, scarcely altered, single in each articulus.
- b. Fronds cartilaginous, four pericentral siphons, cortex parenchymatous. Tetrasporangia in a single spiral line *Lophurella*
Schmitz.
- bb. Fronds filiform, not hair-like, three pericentral siphons, no secondary cortex *Falkenbergia*
Schmitz.
- bbb. Fronds not carnose-cartilaginous, four to 20 pericentral siphons, ecorticate or with a rhizoidal or rarely parenchymatous cortex. Tetrasporangia in a single line, straight or spiral *Polysiphonia*
Greville.
- aa. Branches covered with larger and shorter ramuli of diverse form. Pericentral siphons four.
Ramuli shortly spoon-shaped, incurved, at first spiral and later arboriform, distichous; apices of branches persistent *Chiracanthia*
Falk.

LOPHURELLA Schmitz.

Frond cartilaginous, erect, terete, much branched, the lower ramelli often secund, distichous, structure parenchymatous. Axis polysiphonous, surrounded by four central siphons and almost from the apices to the base surrounded by a thick cortex of minute cellules; monopodial to the apices, with seven transverse cells. Cystocarps globose-ovoid, prolife in young ramuli. Tetrasporangia carried in the upper ramuli sparsely, in the lower ones very plentifully, singly in the articulations, arranged in a long spiral row. Antheridia small cellular bodies, pedicellate, cylindrical. Colour red, drying almost black.

Lophurella periclada (Sond.) Schmitz.

= *Rhodomela pericladus* Sond.

Frond terete, filiform, simple or pinnate, very much branched, with ramelli very spreading and subulate; the lower ones shorter, more simple and further apart; the upper ones much thicker, simple and on the upper side having another set of ramelli. Articulations in young ramelli hardly noticeable. Colour dark purple-brown. Substance rigid.

South Australia (Robe), Victoria (Port Phillip), Tasmania.

Lophurella Hookeriana (J. Ag.) Falkenberg.

Frond 25 cm. to 40 cm. high, terete, filiform, pinnate, irregularly branched, the ramuli erect and patent, virgate. Ramelli curved from the base, acuminate. Stichidia sessile, sublanceolate, a second row of tetraspores on inner side. Cystocarps carried singly at the base of the ramelli. Colour very dark, substance rigid.

Victoria, New Zealand, Cape Horn.

FALKENBERGIA Schmitz.

Frond erect, filiform, glabrous; laterally branched; ramuli spreading in all directions, often twisted together, the ramuli rising from the articulations of the stem. Fronds monopodial. Cells at the apex in seven transverse divisions; the axis is polysiphonous, three central siphons with many others round them, no outer cortex. Tetrasporangia nearly cruciate. Cystocarps and antheridia unknown so far.

Falkenbergia vagabunda (Harv.) Falkenberg.

= *Polysiphonia vagabunda* Harvey.

Frond very small, tangled, patent, the ramuli long, horizontal or widely curved, the ramelli few, often dividing into a series of branchlets, glabrous, articulations nearly as broad as long. Tetrasporangia irregularly scattered, prominent on the sides of the filaments. Colour brownish-red, darker on drying.

Tasmania.

Falkenbergia rufolanosa (Harv.) Schmitz.

= *Polysiphonia rufolanosa* Harvey.

Frond dwarf, nearly round, loosely twisted, filiform, densely covered with fruits, the ramuli irregular and the ramelli attenuated, patent, glabrous at the apices; the ecortical articulations almost as long as broad. Colour brown-red.

West Australia (King George Sound).

POLYSIPHONIA Greville.

Fronds erect, or primarily decumbent and then erect, terete, rarely subcompressed, furcate or laterally branched on all sides, ramuli arranged spirally or irregularly, polysiphonous. Structure parenchymatous or parenchymatous-filamentous. Pericentral cells 4 to 24, surrounding a central cell, bare or corticated with shortly articulate rhizoids, coalescing into a quasi-parenchymatous cortex. Cystocarps ovate globose or suburceolate, borne on the ramuli, enclosed with a cellular pericarp with an apical aperture; carpospores pyriform. Tetrasporangia evolved in upper, slightly thicker, ramuli, either in a longitudinal series which may be interrupted, or spirally disposed, single in each articulus. Antheridia lanceoid or cylindrical, stipitate, on bare ramuli.

The life cycle of *Polysiphonia* is outlined in the introduction.

This is an immense genus, of over 150 species, dispersed over nearly all oceans, from the Arctic circle to the borders of the Antarctic. The species

vary greatly in general appearance; some are of large size, very robust and shrubby, rigid and cartilaginous; others are exceedingly flaccid and slender, membranaceous or gelatinous. In colour they vary from crimson through purple and brownish red to brown. The greater number of species are epiphytic, a few being parasitic. They grow on varied substrata, sometimes typical for a particular species; there may be rocks, stones, shells, wood, or most commonly, other algae.

From the original genus *Polysiphonia*, groups of species have been removed to form new genera, together, in many cases, with other species. At the end of the genus *Polysiphonia* as here given will be found a list of the species hitherto placed in *Polysiphonia*, and now removed to other genera. This arrangement follows De Toni. The genus was divided by J. G. Agardh into two large subgenera; *Oligosiphonia*, in which the number of primary siphons is four, or rarely five; and *Polysiphonia*, in which the number is six or higher. This division is followed here, and the subgenera further divided as given by Harvey in his "*Nereis Australis*," retaining only the groups to which our Australian species belong.

Below are described all the species which have been recorded from the South-western, Southern, and Eastern coasts of Australia, and Tasmania. Only a very few species have been recorded from Northern Australia.

Many of the forms described have only been recorded once or twice, and the descriptions of many are unsatisfactory. The pressing need of the present time is for extensive collecting in many localities, and careful identification from both descriptions and figures and authentic herbarium specimens. This, unfortunately, is far from easy. Many of the descriptions are in Latin, and often unavailable; figures, the main essential, are frequently not given with original descriptions; and type or authentic specimens are often not available. However, it is hoped that this compilation of all Australian records of this genus will be of help to Australian students of the algae, for the field for work on these groups is unlimited.

The main references to each species have been given. These, whenever possible, include one to a figure of the particular species, for in many cases identification is impossible with descriptions alone.

Subgenus *Oligosiphonia*.

Siphons primarily four, rarely five.

I.—ELONGATAE.

Fronds opaque, inarticulate. Ramuli articulate, tetrasiphonous.

Polysiphonia Hookeri Harvey.

Harv. *Nereis Austral.* p. 40, t. XII.; De Toni, *Syll. Alg.* IV., 905.

Frond 30 cm. to 60 cm. long or more, cartilaginous, about 1 mm. in diameter below, gradually attenuated upwards; pinnated with patent branches, much slenderer than the main stem, which gradually diminishes in length towards the apex, giving the frond an ovate outline. Branches once or twice pinnated; branches, pinnæ and pinnulae tapering to the base, inarticulate, closely beset with minute subquadrifarious ramuli, subsimple or forked in younger specimens, terminating in capillary, dichotomous,



Fig. 118.—*Polysiphonia abscissa*.

Fig. 119.—*Polysiphonia Hookeri*.



Fig. 120.—*Polysiphonia Hystrix*.

bysoid fibres; multifid in full-grown fronds; bysoid fibres eventually shed. Articulations only visible in the ramuli, bistriate, one to one and a half times as long as broad. Tetraspores immersed in distorted ramuli. Cystocarps urceolate, tapering to a subacute apex, sessile on the sides of the ramuli. Colour a dark red-brown.

South Australia (Eastern Bays, Encounter Bay), Tasmania, Victoria.

Polysiphonia longissima J. Agardh.

De Toni Syll. Alg. IV., 906.

Frond 15-20 cm. long, filiform, sparsely pinnate, irregularly branched; ramuli sparse, formed on every side, naked below, subulate above, scattered with minute spines. Four central siphons, corticate with striate elongate cells to the apices of the branches. Stichidia minute, single or in small subfasciculate clusters, fusiform, articulate; articulations always longer than broad; tetraspores towards outside of stichidia, not prominent. Colour purple.

Southern Australia.

Polysiphonia hystrix Hook. fil. et Harvey.

Harv. Nereis Austral. p. 41, t. XIV.; De Toni Syll. Alg. IV., 906.

Frond setaceous, cartilaginous, inarticulate, branching vague or subdichotomous; branches long, far apart, and remarkably arched; smaller branches patent, similar, all covered with multifid ramuli for their whole length; ramuli short, subulate, spinose, more compound when fully grown, usually with the apex prolonged beyond the branching part into a subulate acumination. Tetraspores lying to the side of ramuli. Cystocarps laterally inserted on the ramuli. This species is closely allied to *P. Hookeri*, but presents a quite different aspect, as shown in the figures.

South Australia (Encounter Bay, Eastern Bays, Holdfast Bay), Western Australia, Tasmania.

Polysiphonia Mallardiae Harvey.

Harv. Nereis Austral. p. 40, t. XIII.; De Toni Syll. Alg. IV., 908.

Frond 15 cm. to 20 cm. long or more, about 1 mm. thick, branched with greater or less regularity in an alternately pinnate or bipinnate manner. Lower stem and branches naked and smooth, upper portion and all branches and pinnulae densely clothed with short, quadrifarious, imbricated, multifid ramuli; ramuli about 2 mm. long, rigid, patent or horizontal, irregularly dichotomous, the only parts showing articulations; articulations as long as broad, bistriate, with obscure dissepiments. Tetraspores immersed in the scarcely distorted upper ramuli, in a single row. Cystocarps ovate-urceolate, with a slender protruding mouth, sessile on the ramuli. Colour in the dry state intensely black. Closely related to *P. Hookeri*.

South Australia (Eastern Bays), Western Australia, Tasmania, New Zealand.

Polysiphonia Daveyae Reinbold.

Reinb. Meeresalgen von Inv. Str. (1889) p. 49, n. 97; De Toni Syll. Alg. IV., 913.

Frond tall (15-20 cm.), laterally branched, corticated to the smaller branches, four siphoned; about 1 mm. thick at the base, rigid; flexible

above. Branches erecto-patent, elongate, densely branched, with simple furcate, sparse and irregular ramuli. Secondary and tertiary branches dichotomous, lateral branches subfastigiate. Articulations as long or slightly longer than broad. Tetrasporangia borne in ecorticate ramelli, which are often furcate. Colour brown. Adheres to paper.

Only recorded from Investigator Strait, South Australia.

Polysiphonia crassiuscula Harvey.

Harv. Fl. Tasm. II., p. 299; De Toni Syll. Alg. IV., 885.

Fronds 10 cm. to 15 cm. high, not densely tufted, repeatedly dichotomous from the base, the lower axils very patent; cartilaginous, thickly coated with secondary cells in the lower part, softer and more pellucid above, at



Fig. 121.—*Polysiphonia Mallardiae*.

Fig. 122.—*Polysiphonia frutex*.

the ends of the branches flaccid, much attenuated and pellucid. Articulations short in all parts of the frond, only equalling their diameter towards the end of the young branches, tetrasiphonous; lower articulations more or less obliterated, being covered externally with several rows of accessory cells. Tetraspores borne towards the apex of branched ramuli in dense fasciculate clusters; ramuli slightly swollen in region of tetraspores. Colour a dingy reddish-brown when dry. Substance rigid, the tips only adhering to paper.

South Australia (Eastern Bays), East Coast of Tasmania.

Polysiphonia dasyoides Zanardini.

Zanard. Phyc. Aus. Nov. (1874), p. 489, n. 10; De Toni Syll. Alg. IV., 954.

Frond corticate to the apices, pinnately branching, branches spreading to all sides. Clothed with simple, furcate, dense, four siphoned ramuli, apices ocellate. Primary articulations all obsolete; in the ramuli the diameter twice the length. Colour red. Substance soft, succulent.

Georgetown, Tasmania.

II.—DICHOTOMAE.

Total frond pellucidly articulate, subdichotomous, branched. Ramuli tetrasiphonous.

Polysiphonia Rocana Harvey.

Harv. Phyc. Aus. t. 35; De Toni Syll. Alg. IV., 877.

Fronds tufted, 7 cm. to 15 cm., long, very fine, excessively and very irregularly branched; primary divisions dichotomous with frequent suppression of one arm of the fork, becoming irregularly zig-zag; secondary branches either alternate or very commonly secund, repeatedly compounded; lesser branches tapering gradually to a point. Articulations pellucid in all parts, composed of four tubes surrounding a minute cavity; the lower several times as long as broad, the upper gradually shorter, ultimate ones scarcely longer than broad. Colour brilliant rosy-red, well preserved on drying; adheres to paper. Substance soft and very flaccid, but not gelatinous; does not rapidly decompose in fresh water.

Dredged off Fremantle, West Australia.

Polysiphonia mollis Hooker et Harvey.

Harv. Nereis Austral. p. 43; De Toni Syll. Alg. IV., 877.

Fronds erect, solitary or approximating, but scarcely tufted, to 15 cm. high, setaceous at the base, then capillary, and exceedingly slender above, much branched. Primary stem subdichotomous, but soon lost in the excessive division of the branches and ramuli, which are again and again decompounded in an irregularly dichotomous manner; the ultimate ramuli simple, elongate and erecto-patent, fibrilliferous. Articulations in the lower part very short, those of the principle divisions twice as long as broad, those of the smaller branches gradually shorter. Stem tetrasiphonous. Tetraspores borne in series in apices of distorted flexuose ramuli. Cystocarps very numerous, minute, shortly stalked, ovate, acute.

South Australia (Encounter Bay, Eastern Bays, North Coast of Kangaroo Island), Tasmania, Western Australia.

Polysiphonia succulenta Harvey.

Harv. Fl. Tasm. p. 300; De Toni Syll. Alg. IV., 879.

Frond ultrasetaceous, gelatinose-cartilaginous, to 15 cm. high; much branched dichotomously from the base. Tetrasiphonous, articulate, the articulations below three times as long as broad, ultimately as long as broad. Tetraspores in dense fasciculato-multifid terminal ramuli. Cystocarps numerous, shortly stalked, ovate. This species resembles a large and coarsely grown *P. mollis*, but the frond is much more robust and succulent, and the branching more regularly dichotomous.

South Australia (American River, Kangaroo Island), Tasmania, Victoria.

Polysiphonia abscissa Hooker et Harvey.

Syn. *P. microcarpa* H. and H.

Harv. in Lond. Journ. Bot. IV., p. 266; Harv. Nereis Austral. p. 43; De Toni Syll. Alg. IV., 879.

Fronds 6 cm. to 10 cm. long, ovate in outline, membranaceous-gelatinous, flaccid, tenaceous. Primary stem sparingly divided, flexuose, emitting

secund, alternate, multifid, filiform branches, becoming shorter towards the apex; ramuli fibrilliferous, fastigiata. Articulations in branches 4-6 times, in ramuli 2-3 times as long as their diameter; bistriate. Cystocarps small, ovate, shortly pedicellate. Colour purplish-red or crimson.

South Australia (Pennington Bay, Kangaroo Island).

Victoria, Tasmania, New Zealand, Cape Horn.

Polysiphonia laxa Harvey.

Harv. Fl. Tasm. II., p. 300; Kütz, Tab. Phyc. XIV., t. 3; De Toni Syll. Alg. IV., 883.

Frond to 30 cm. high, slender, setaceous, somewhat rigid. Branching lax, the branches distant, zigzag-bent, throwing off branchlets at the angles; principal branches several cm. long, variously set with short lateral branches, often secund, subsimple, slightly branched, or with a few setaceous ramuli; all the ramification remarkably patent. Articulate, tetrasiphonous, ecorticate, median articulations 3-4 times, the upper twice, the ultimate as long as broad. Tetrasporangia in sublanceolate ramuli, small, uniseriate. Colour reddish.

Tasmania, on *Zostera*.

Polysiphonia implexa Hooker et Harvey.

Harv. in Lond. Journ. Bot IV., p. 538; Kütz. Tab. Phyc XIV. (1864) p. 12, t. 36; De Toni Syll. Alg. IV., 889.

Caespitose, forming wide, lax, intricate patches on rocks about 2.5 cm. high. Attached to substratum by adhesive discs. Primary stems decumbent, radical, about 225μ thick; secondary branching irregular, articulate; lower branches dense, upper sparse, attenuate at the base; ramuli subulate, patent, divaricate, articulate, tetrasiphonous; articulations as long as broad. Colour dark purple. Adheres to paper.

Western Australia (epiphytic on Corallines, King George Sound), Lord Howe Island, New Zealand.

Polysiphonia sphacelarioides J. Agardh.

J. Ag. Till. Alg. Syst. IV. (viii.) p. 100; De Toni Syll. Alg. IV., 890.

Frond laxly intricate, expanded on all sides, totally ecorticate, capillary, elongate, rooting here and there. Branches distant and densely ramellate, the rachis bare and prominent; ramelli almost vertical, alternate, subsecund, the young attenuated at the base; older branches soft, articulate, tetrasiphonous; articulations 2-3 times as long as broad, in the ultimate ramelli as long as broad. Colour reddish. Adheres to paper.

South Coast of Australia.

Polysiphonia infestans Harvey.

Harv. Tr. Irish Acad. XVII., p. 539; Kütz Tab. Phyc. XIV. (1864), p. 14, t. 40; De Toni Syll. Alg. IV., 891.

Fronds 4-8 cm. high, setaceous, attenuated above, pellucidly articulate, much branched. Branches patent, often alternate or interspersed with vaguely divided ramuli; ramuli capillary, simple, patent, tufted; axils

wide; tetrasiphonous, lower articulations longer than broad, upper about as long as broad. Colour pale violet-red, drying black. Substance cartilaginous. Adheres to paper.

Western Australia (epiphytic on *Polyphysa peniculus*, King George Sound).

Polysiphonia ferulacea Suhr.

Syns. *P. littoralis* Harvey mser; *P. breviarticulata* Harvey; J. Ag. Sp. II., 3, p. 980; De Toni Syll. Alg. IV., 892.

Fronds caespitose, 6-15 cm. long, dense, rising from intricate rooting masses. Stems slender, mostly undivided below, irregularly dichotomous above, subfastigate, one branch of a dichotomy often shorter than the other, all axils very acute. In fertile plants the dichotomous lateral branches are short, dense, irregularly fastigate, basal part swollen with tetrasporangia, long and attenuate above; ramuli of sterile plants often simple, usually sparse, less attenuated, apices obtuse; lower ramuli patent, upper erect. Articulations in whole frond of subequal length, diameter shorter or equal to length; tetrasiphonous, ecorticate. Lower nodes swollen, ascending stem often emitting rooting filaments downwards. Tetraspores in lateral fastigate ramuli, distorted below the apices; extra lateral ramelli prominent. Cystocarps on upper branches, below the apices, sessile, globose, ovate. Colour reddish.

South Australia (Eastern Bays), Western Australia, Tasmania, Gulf of Mexico, Indian Ocean.

Polysiphonia havanensis Montagne.

Kütz. Tab. Phyc. XIII., t. 72; De Toni Syll. Alg. IV., 894.

Fronds caespitose, erect, elongate, stems at base articulate and forming nodose masses; irregularly dichotomous, more or less dense, virgate; ramuli long, attenuated, patent. Tetra-siphonous, articulations below 6 times, above 2-3 times, as long as broad. Tetrasporangia in unequal ramuli, verrucose, sparse. Cystocarps ovate, sessile on upper branches. Colour red-brown.

South Australia, Western Australia, Havana, Cuba, Florida. Harvey records this species from Lake King, which is 22 miles east of Lake Frome, in the north of South Australia. This lake is probably little more than a large salt pan, but it is a remarkable place to find a *Polysiphonia*.

Polysiphonia Blandi Harvey.

Harv. Phyc. Aus. t. 184; De Toni Syll. Alg. IV., 899.

Fronds solitary or few together, not entangled 6 cm. to 10 cm. long, about $\frac{1}{2}$ mm. thick, repeatedly but irregularly forked; the lowest divisions mostly dichotomous, the upper more alternate; all the lower naked, with distant forks and acute axils; the upper somewhat virgate, closely set throughout with short multifid ramuli. Ramuli 4-6 mm. long, corymbose, alternately multifid; all their divisions densely fibrilliferous, with dark-coloured dichotomous fibres. Articulations short; the lower little longer than the upper, none more than three times as long as broad, tetrasiphonous, with thick walls. Tetraspores in distorted ultimate ramuli.

Cystocarps sessile, very wide in proportion to the length, with large apertures, lateral or terminal. Colour very dark, rich red-brown, becoming darker and browner in drying. Substance soft and rather flaccid, adheres to paper. Most closely related to *P. mollis* of the Australian species.

South Australia (Eastern Bays), Victoria.

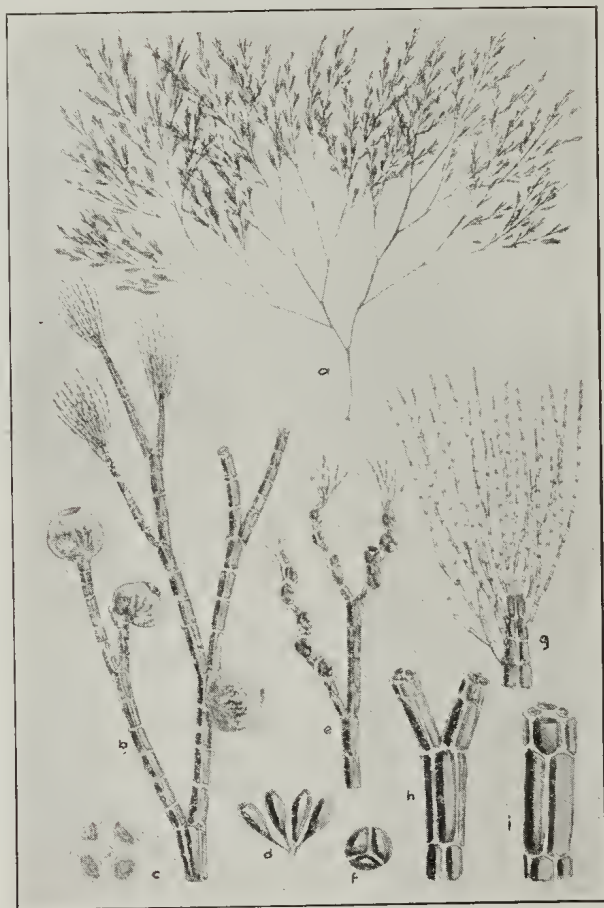


Fig. 123.—*Polysiphonia Blandi*: a, plant; b, part of a branch, bearing ceramidia; c, cross-section of branch; d, spores; e, apex of a branch, bearing tetraspores; f, a tetraspore; g, fibrilliferous apex; h and i, portion of frond, showing articulations of various lengths. (After Harvey.)

Polysiphonia flavesces Zanardini.

Zanard. Phyc. Austral. Nov. (1874), p. 490, n. 11; De Toni Syll. Alg. IV., 955.

Frond almost setaceous, ecorticate from the base, branching dichotomous-pinnate; ultimate ramuli attenuate, elongate, fibrilliferous; tetrasiphonous, articulate, pellucid; primary articulations 1-6 times as long as broad. Tetrasporangia large, ellipsoid, occupying lateral ramuli on all sides, attenuate and subtorulose. Colour rose. Substance flaccid.

Tasmania (Georgetown).

Polysiphonia spinuligera Zanardini.

Zanard. Phyc. Austral. Nov. (1874), p. 490, n. 12; De Toni Syll. Alg. IV., 955.

Fronds ecorticate from the base, almost setaceous, irregularly dichotomous-fastigate, covered with interspersed spiniform ramuli. Tetrasiphonous, articulations as long or slightly longer than broad; lower remarkably nodose. Colour dark-red. Substance rigid.

Tasmania (Georgetown).

Polysiphonia macrarthra Zanardini.

Zanard. Phyc. Austral. Nov. (1874), p. 490, n. 13; De Toni Syll. Alg. IV., 955.

Fronds totally ecorticate setaceous, much branched irregularly, branches and ramuli alternate, ultimate ones in lateral congested fascicles. Tetrasiphonous, very pellucid, primary articulations 20 times as long as broad, ultimately as long as broad. Tetrasporangia occupying the upper ramuli, sparsely produced.

Tasmania (Georgetown).

Polysiphonia gelidii Zanardini.

Zanard. Phyc. Austral. Nov. (1874), p. 490, n. 14; De Toni Syll. Alg. IV., 955.

Fronds small, very slender, subdichotomously branched; ultimate ramuli lateral, subulate, attenuate. Tetrasiphonous, primary articulations 2-6 times as long as broad, secondary about as long as broad. Cystocarps spherical, sessile on the branches.

Lord Howe Island (on fronds of *Gelidiaceae*).

Polysiphonia zostericola Lucas.

Proc. Linn. Soc. N.S.W., XLIV., p. 177.

Fronds gregarious, forming a thick fringe to *Zostera* leaves; not intricate, slender, to 2.5 cm. long. Fronds attached by a small basal disc, branching below dichotomous, above more pinnate; branches emitted at an angle of 45°, giving off, at rather long intervals, other like but gradually slenderer branchlets, the last very slender and sometimes secund. Main axis 180 μ thick; basal articuli 1 x 1, of ramuli 2 x 1, of tetrasporangiferous ramelli 1 x 1. Tetrasiphonous. Tetrasporangia small, in little distorted ramelli. Cystocarps nearly sessile, ovate, 326 μ x 258 μ , contracted at base. Substance rather firm, standing prolonged immersion in water. Colour brownish-purple, darker on drying. Adheres closely to paper.

Botany and Middle Harbour, N.S.W. Abundant on *Zostera* leaves in salt and brackish water.

Polysiphonia Baxteri Lucas.

Proc. Linn. Soc. N.S.W. LX., p. 224.

Fronds growing as a fringe on the fruiting stem of *Gracilaria*. Branches 150 μ thick at base, diminishing upwards. Joints 2 x 1 below, ultimately

1 x 1. Tetrasiphonous. Cystocarps with a one-jointed pedicel, nearly spherical, 170 μ diameter. Height about 1 cm. Colour violaceous.

Lord Howe Island.

Polysiphonia rutilans Kützinger.

Kütz. Tab. Phyc. XIII., t. 35: De Toni Syll. Alg. IV., 954.

Frond densely caespitose, intricate, prostrate, ecorticate; branches remote, alternate. Articulate, tetrasiphonous, articulations as long as broad, siphons subarticulate. Colour golden-black.

Australia. Little known. De Toni queries whether this species should not be placed under *Lophosiphonia*.

Polysiphonia amoena Sonder.

Kütz. Tab. Phyc. XIV., [1864], p. 13, t. 40: De Toni Syll. Alg. IV., 959.

Fronds erect, 4-7 cm. long, much branched, branches erect, apices corymbose-fastigiate. Tetrasiphonous. Articulate, lower articulations 3-4 times as long as broad.

Victoria (Port Phillip).

Subgenus *Polysiphonia*.

Siphons primarily six or more.

A. Fronds pellucidly articulate.

III.—CANCELLATAE.

Siphons usually seven, rarely eight or nine. Fronds dark, drying darker, furrowed, bushy, vaguely branched. Ramuli irregular.

Polysiphonia forcipata Harvey.

(Syn *P. forster* Harvey.)

Harvey Phyc. Aus. pl. 96: De Toni Syll. Alg. IV., 920.

Fronds erect, solitary or two or three together, but not densely tufted, 4-8 cm. high, about $\frac{1}{2}$ mm. to $\frac{1}{2}$ mm. thick, repeatedly and fairly regularly dichotomous: in old specimens only lateral branches may be dichotomous; smaller branches regularly forked, with the tips of the ramuli acute and approaching each other in pairs, like the arms of scissors. Frond pellucidly articulate, the articulations shorter than broad in all parts of the frond. Siphons five (six according to Harvey), lateral view quadrate. Tetrasporangia in lateral cells of corymbose ramuli, prominent. Cystocarps sessile or nearly so, lateral, at some distance below the last ramifications; very broadly ovate, somewhat broader than long, surface laxly areolate. Colour when growing a pale reddish-grey, more or less tinted with red; when dry, either red-brown or blackish. Substance firm, cartilaginous. Adheres weakly to paper.

Western Australia (Rottne Island, Garden Island, King George Sound)—epiphytic on *Zostera* and smaller algae. Tanega Island, Eastern Archipelago.

Polysiphonia frutex Harvey.

Lond. Jour. Bot. III., 439; Harv. Nereis Australis, p. 52; Kützing, Tab. Phyc. XII., t. 21; De Toni Syll. Alg. IV., 925.

Fronds 5-10 cm. high, forming globose bushy tufts, branching in every direction from the immediate base, the branches equalling the stem in length, or no distinct stem visible; all excessively branched, the lesser branches alternate, very patent or divaricate, setaceous below, attenuated upwards, straight, bi-tripinnate, with distant alternate pinnae; these in turn bearing distant, short, spine-like pinnulae, which are sometimes again pinnellate; all the apices terminating in colourless byssoid fibres. Articulations visible from base to apex, very short. Stem shows seven siphons surrounding a small central siphon; stem furrowed. Cystocarps lateral on upper ramuli numerous, shortly stalked, ovate. Colour dull-grey or brownish. A more slender plant than *P. cancellata*, more densely tufted, with rather larger joints and less comparative difference in diameter between each successive series of branches.

South Australia (Pennington Bay, Kangaroo Island), Victoria, Tasmania.

Polysiphonia fuscescens Harvey.

Lond. Jour. Bot. III., 439; Harv. Nereis Australis, p. 52; Kütz. Tab. Phyc. XIII., 67; De Toni Syll. Alg. IV., 925.

Fronds to 2 cm. high, excessively branched and bushy, but not so shrub-like as *P. frutex*; much divided from near the base into long erect branches or stems, generally simple, sometimes emitting long branches similar to themselves. Branches linear or narrow-lanceolate, closely bipinnate throughout their length, the pinnae very short relative to the length of the branch, erect or erecto-patent, pinnulated with short simple spine-like ramuli, the apices beset with byssoid fibres. Articulations of the stem and branches four-triangular, two-four times longer than broad. Tetrasporangia on slightly verrucose ramuli. Colour dull-brown or grey. Adheres well to paper. Nearly allied to *P. frutex*, but differing in habit and clearly in the length of the articulations.

Victoria, Tasmania.

Polysiphonia cancellata Harvey.

Lond. Jour. Bot. III., 440; Harv. Nereis Australis, p. 51, tab. XV.; De Toni Syll. Alg. IV., 928.

Fronds 8-14 cm. high, very robust ($\frac{1}{2}$ -1 $\frac{1}{2}$ mm. thick), excessively branched and bushy; branches many times alternately divided, the main divisions spreading in all directions, forming a globose frond. Secondary branches much thinner than those they spring from, tapering to a fine point; bearing ramuli greatly more slender than themselves. Articulate, seven siphoned, articulations very short, marked with four wide colour cells, separated by broad pellucid spaces, giving the frond a netted appearance under a lens. Tetrasporangia in subsecund stichidia-like ramuli. Cystocarps small, shortly pedicellate, ovate. Colour brownish, darker when dry. Adheres to paper.

South Australia (Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays Western Australia, Tasmania.

Polysiphonia nigrita Sonder.

J. Ag. Sp. Alg. ii., 1048; Harv. Nereis Australis, p. 51; De Toni Syll. Alg. IV., 928.

Frond very similar to *P. cancellata*, with very thick main stems, vaguely branching; branches elongate, erecto-patent, decomposite; ramuli stout, slightly curved, subulate, spinaeform, sparse. Articulate, eight-nine siphons, articulations very short. Drying jet black. Substance rigid.

De Toni includes *P. nigrita* under *P. cancellata* Harvey, and they are undoubtedly very closely related. However, in South Australian specimens of typical *P. cancellata*, the siphons of the larger branches in particular, and also the smaller, are arranged in very regular transverse layers, while in typical *P. nigrita* they are very much more irregular, forming no definite transverse layers. The ramuli of *P. nigrita* are stouter, and the colour very much darker than in *P. cancellata*. In well developed specimens the terminal dichotomous fibres on the ramuli are well developed in *P. cancellata*, but almost absent in *P. nigrita*. Harvey also recorded eight or nine siphons in the main stem of *P. nigrita* and only seven in *P. cancellata*. South Australian specimens show normally seven large siphons, with an occasional small eighth, in both forms. The principal distinction seems to be in cell arrangement and colour, and a dozen or so specimens examined were not difficult to separate on these characteristics. A much larger series of specimens is required to determine the validity of these distinctions, but *P. nigrita* seems to be at least a distinct variety of *P. cancellata*, and they are, therefore, separated here.

The following species has been recorded from Victoria, but De Toni's description is almost useless. The group to which it belongs cannot be ascertained without examination of authentic specimens, and it is placed after Cancellatae (seven, eight or nine siphons) for convenience.

Polysiphonia caespitula Sonder.

Kütz. Tab. Phyc. XIX (1864), p. 15, t. 43; De Toni Syll. Alg. IV., 960.

Fronds ecorticate. Eight siphoned.

Victoria (Wilson Promontory).

IV.—ATRO-RUBESCENTES.

Siphons 10-16 or more. Fronds bright red, drying darker, cylindrical, branching vague or pinnate. Ramuli irregular.

Polysiphonia atricapilla J. Agardh.

J. Ag. Sp. II., 3, p. 1054; De Toni Syll. Alg. IV., 934.

Fronds to 15 cm. high, branching irregular, pinnate; intertwined with finer virgate ramuli, glabrous at base, articulate and ecorticate. Ramuli widely spread, almost horizontal, sublinear, attenuated, obtuse, the lower slightly rigid. Twelve siphoned, articulations all short. Tetrasporangia in slightly verrucose ramuli, sparse, prominent.

South Australia (Lacepede Bay), Western Australia.

Polysiphonia aurata Harvey.

Harv. Acc. of W. Aus. no. 95; De Toni Syll. Alg. IV., 933.

Fronds caespitose, 10-20 cm. high, filiform, articulate, irregularly branched; branches alternate or dichotomous, erect, patent; ramuli alternate or secund, apices furcellate. Ten siphoned. Articulations below two-three times as long as broad. Stem seven furrowed. Tetrasporangia large, almost solitary. Cystocarps ovate, sessile. Colour red-brown.

Western Australia (King George Sound).

The following two species have also been recorded, but very meagre descriptions are given by De Toni. Examination of type or authentic specimens is required. They are included here as they are ten siphoned:—

Polysiphonia Argus Kützinger.

Kütz. Tab. Phyc. XIV. (1864), p. 17, t. 48; De Toni Syll. Alg. IV., 960. Ten siphoned.

Victoria (Western Port).

Polysiphonia angustissima Kützinger.

Kütz. Tab. Phyc. XIV. (1864), p. 17, t. 47; De Toni Syll. Alg. IV., 960.

Fronds ecorticate 10 siphoned, with very short articulations. Similar to *P. Roana*.

Victoria (Brighton Beach, Port Phillip).

B. Fronds more or less inarticulate.

V.—FULIGINOSAE.

Siphons 12-16 or more. Fronds tall, inarticulate and corticated at the base, apices pellucidly articulate.

Polysiphonia virgata (Ag.) Spreng.

(Syn. *P. fuliginosa* Rud.)

Harv. Nereis Austral., p. 56; Kütz. Tab. Phyc. XIII., t. 59; De Toni Syll. Alg. IV., p. 952.

Fronds 30 cm. to 50 cm. tall, terete, becoming slenderer upwards; inarticulate, opaque, simple or once or twice forked below, with long virgate, quadrifarious branches throughout, these in turn with lateral branchlets which are again branched. Articulations, where visible, as long as broad. Stem and large branches consisting of a central tube surrounded by a broad belt of small irregular cells, in many rows, round which 16 tubes radiate in an elliptic curve, again surrounded by another broad belt of cells; lesser branches consisting of a central tube surrounded by 16 others, and with a very narrow external cellular coat; a ramulus shows only 16 primary tubes. Tetrasporangia in accessory, dichotomous ramuli in the axils of penultimate branchlets. Cystocarps globose-urceolate, disposed on small adventitious ramuli. Colour dark reddish-brown. Substance cartilaginous, soon decomposing in fresh water.

Australia (doubtful), Cape of Good Hope, Brazil.

Lucas described the following nine-siphoned species from New South Wales, but did not discuss its relation to other species, so it cannot at present be included in any of the above groups:—

Polysiphonia compacta Lucas.

Proc. Linn. Soc. N.S.W., XXXVIII., p. 56.

Fronds forming cushion or moss-like patches covering and following the inequalities of rocks; patches variable in outline, irregularly oval, up to 8 cm. or more in diameter, sometimes confluent. Lower layer forming a firm imbricate reticulum; the upper, to 10-15 mm. high, consisting of free ramuli, very soft. The primary filaments, somewhat stouter than the secondary, creep over the rock surface, and are attached to it by numerous simple or forked colourless rhizoids, up to five from one articulation; each rhizoid terminating in an expanded adhesive disc. Nine siphons. Each articulation separated by a narrow colourless zone. Tetrasporangia extending in a series of up to nine or more in the centre of the ramuli, not moniliform; fertile ramulus often branched, sometimes bearing an immature fertile ramellus.

Farm Cove, Port Jackson, New South Wales. In rock pools left by falling tide.

Below are listed the Australian species once placed in *Polysiphonia*, and which have now been removed to other genera. Descriptions of South Australian species will be found on other pages of this book, and all are dealt with by De Toni.

P. rufolanosa Harv. = *Falkenbergia rufolanosa* (Harv.) Schmitz.

P. vagabunda Harv. = *F. vagabunda* (Harv.) Falk.

P. ericoides Harv. = *Bryocladia ericoides* (Harv.) Schmitz.

P. tasmanica J. Ag. = *Pityopsis tasmanica* (Sond.) Falkenberg.

P. valida J. Ag. = *Chiracantha valida* (J. Ag.) Falk.

P. pennata J. Ag. = *Pterosiphonia pennata* (Roth.) Falk.

P. cladostephus Mont. = *Brongniartella australis* (Ag.) Schmitz.

**P. Patersonis* Sond. (*P. spinosissima* Harv.) = *B. (?) Patersonis* (Sond.) De Toni.

P. dendritica Ag. = *Dipterosiphonia dendritica* (Ag.) Falk.

P. prorepens J. Ag. = *Dipterosiphonia prorepens* (J. Ag.) Falk.

P. filipendula Harv. = *Ilerposiphonia filipendula* (Harv.) Falk.

P. monilifera H. and H. = *II. monilifera* (H. and H.) Falk.

P. pectinella Harv. = *II. pectinella* (Harv.) Falk.

P. prorepens Harv. = *II. prorepens* (Harv.) Schmitz.

P. rostrata Sond. = *II. rostrata* (Sond.) Falk.

P. versicolor H. and H. = *II. versicolor* (H. and H.) Falk.

(De Toni includes *P. scopulorum* Harv. and *P. Pecten* Aresch. under *Ilerposiphonia*.)

P. calothrix Harv. = *Lophosiphonia calothrix* (Harv.) De Toni.

P. neglecta Harv. = *L. (?) neglecta* (Harv.) De Toni.

P. prostrata Harv. = *L. prostrata* (Harv.) Falk.

* Recent examination shows that this species has hairs confined to the ramuli ends, and therefore belongs to the Cancellatae group of *Polysiphonia*, as originally placed.

P. simpliciuscula Crouan = *Ophidocladus simpliciusculus* (Crouan) Falk.

P. callithamnion (Sond.) = *Heterosiphonia callithamnion* (Sond.) Falk.

CHIRACANTHIA Falkenberg.

Fronds erect, terete, laterally branched. Branches elongate, polysiphonous, at length showing dorsiventral construction. Ramuli in lower part covered with aculiform ramelli. Axis polysiphonous, four pericentral cells, soon evolving a parenchymatous cortex. Cystocarps single on short ramuli. Tetraspores undulating in thick torulose stichidia, in a single spiral series.

Chiracanthia valida (J. Ag.) Falkenberg.

= *Polysiphonia valida* J. Agardh.

Frond 15 cm. to 25 cm. long, pinnate, irregularly branched, the ramuli and ramelli alternate as far as the apices which are corticate and have no ramelli. The ramelli are short and distantly spaced in a congested subquarrose mass, on a short stem. The ramelli are rigid, subulate, articulate and polysiphonous. Cystocarps pedicellate, subterminal, globose, with a prominent orifice. Dark-red, drying black.

South Australia (Investigator Strait, Eastern Bays), South Coast generally.

Chiracanthia arborea (Harv.) Falkenberg.

Fronds 20 cm. to 50 cm. long, dendroid, excessively branched, opaque in all parts; main stem about 2 mm. in diameter, attenuated upwards. Branches spreading to all sides, bushy, several times decompound, all the divisions erecto-patent, inserted in an irregularly spiral order. Ramuli spine-like, very minute and closely set, with two to three incurved, subfalcate teeth at the extremity. Cystocarps ovate, on long stalks, densely cellular. Colour dark-brownish or brownish-red. Substance tough.

South Australia (Eastern Cove (Kangaroo Island)), Tasmania.

Subfamily Pterosiphonieae Falkenberg.

KEY TO THE GENERA.

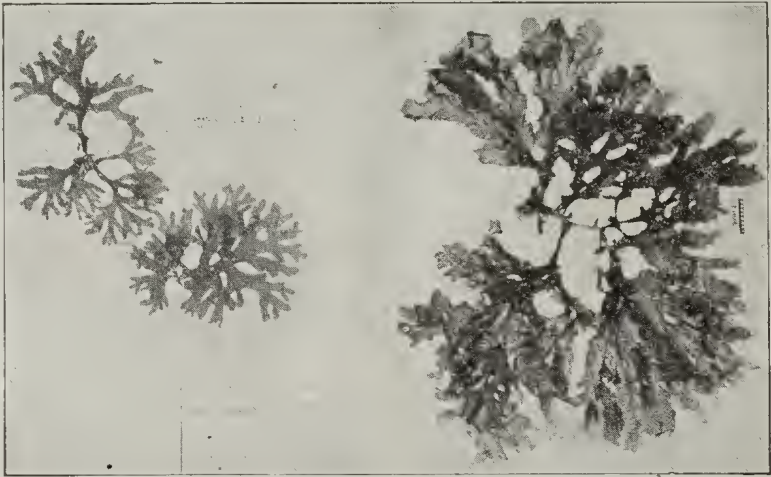
- a. Pericentral cells four; fronds consisting of long branches in the one plane, irregularly lobed, below decumbent, above erect *Pollexfenia* Harv.
- aa. Pericentral cells six: fronds erect, distichously branching, branches tall *Dictymenia* Grev.

POLLEXFENIA Harvey.

Fronds plane, membranaceous, rose-purple, expanded, ecostate or with a median costa, lacerate, areolate, formed of polygonal cells. Pericentral siphons four. Cystocarps arising from the frond, ovate, osteolate, pericarp thick, carinose, sessile or pedicellate; carpospores pyriform. Stichidia obovate-oblong, subarticulate; tetrasporangia alternately disposed.

Pollexfenia pedicellata Harvey.

Frond 10 em. to 12 em. long, and equally broad, delicately membranous, with an orbicular outline, more or less deeply divided in a mixed diehotomous and pinnate manner; the segments spreading simple or pinnatifid, the spaces between them wide and rounded; the apices obtuse, and the margin entire. The substance is very thin, areolated, and destitute of costa, but the frond is transversed throughout with a wide band of pellucid veinlets, or internal filaments, which have the appearance, under a pocket lens, of delicate striae. These veinlets originate at the base of the frond, and radiate towards all the segments, passing through the centre of each, and evidently supply the place of a midrib, without taking its appearance. They are most obvious towards the apices, which is not usually the case with costae or nerves. Colour rosy-purple, becoming brownish-red in drying. Cystocarps

Fig. 124.—*Pollexfenia pedicellata*.Fig. 125.—*Pollexfenia lobata*.

abundantly scattered over both surfaces, ovate, acuminate, born on stalks as long as themselves. Stichidia also thickly dispersed, tufted, ovate-lanceolate.

South Australia (Holdfast Bay, Encounter Bay, Eastern Bays), Western Australia, Tasmania.

Pollexfenia lobata (H. & H.) Falkenberg.

= *Jeannerettia lobata* Hooker fil. and Harvey.

Attachment or hold-fast small, discoid. Fronds tufted 25 em. to 50 em. long, and as much in the expansion of the segments, rising with a filiform, slender stem, which at 2 em. to 8 em. above the hold-fast passes into the base of the frond, and is continued upwards as a midrib. This midrib sends off lateral branches, one of which traverses each lobe of the frond until it is lost near the apex; and the larger branches throw out other laterals, directed towards the smaller lobes. The frond is delicately membranous, but of firm and somewhat rigid substance, and is subdiehotomously divided; the lesser segments alternately ineiso-pinnatifid, or lobulate. The margin is everywhere undulated, and the lobes very obtuse. In old specimens the midrib is proliferous, emitting similar fronds. Under a pocket lens the

lamina appears to be obliquely striate from the midrib to the margin, and especially at the apices of the laciniae it is marked with radiating striae; these striae are internal veinlets, forming part of the axial system of the membrane. The membrane is composed of a double row of quadrate cells; the midrib of several rows of similar but smaller cells. Cystocarps are tufted, pedicellate, ovate, and contain a tuft of pedicellate, pyriform spores. The stichidia, also tufted, are fusiform or clavate, simple and contain a double row of tetraspores. The substance is firmly membranous, glossy when dry, and adheres to paper. The colour is a dark vinous-purple, changing to black when dry.

South Australia (LeFevre Peninsula, Encounter Bay, Eastern Bays), Tasmania.

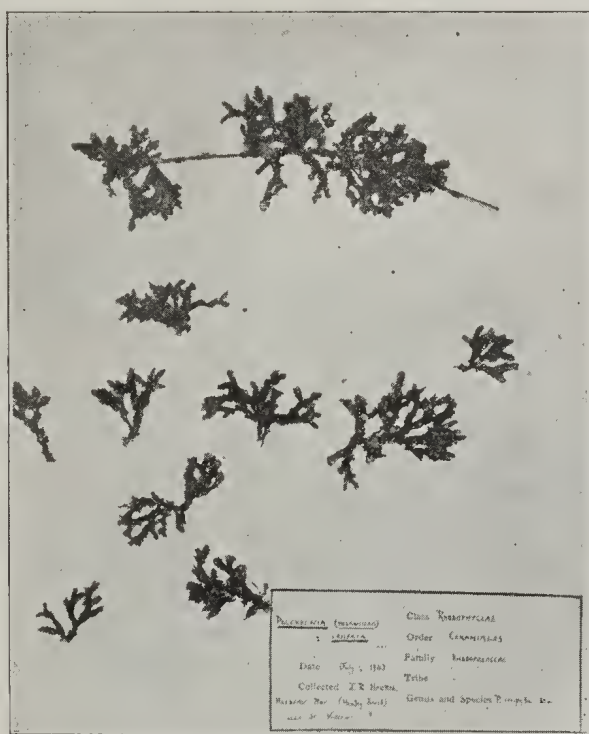


Fig. 126.—*Pollexfenia crispata*.

Pollexfenia crispata (Zanard.) Falkenberg.

Frond branching rapidly from the base, dichotomous, the margin very waved, and fertile frond covered with short hairs. Stichidia short and claviform, the fruit in the apices in four long regular rows.

South Australia (Holdfast Bay, Encounter Bay), Victoria (Port Phillip).

Pollexfenia crenata J. Agardh.

Frond dwarf, almost lanceolate, pinnate and irregular on the margins; the younger fronds overlap very much at the base, gradually less so as they grow. The fully developed plant is sublanceolate, the margins suberenate. Stichidia rising chiefly from one frond; this may be due to chance, or the age of the plant.

South coast of Australia.

Pollexfenia nana J. Agardh.

Frond dwarf, 5 cm. to 8 cm. high, palmate or lobate, the lobes small, obtuse at the apices, often very wide; the margin is unbroken. Stichidia subfasciculate, scattered. Structure and fruit scarcely different from *P. pedicellata*.

South coast of Australia.

DICTYMENIA Greville.

Frond flat, membranaceous, midribbed, alternately decompound, pinatifid, areolate; the medullary cells large, 12-sided, colourless, transversely set; the cortical minute, irregular, coloured. Cystocarps ovate, stipitate, containing a tuft of pear-shaped spores. Stichidia simple or branched, containing tripartite tetraspores.

Dictymenia Sonderi Harvey.

Attachment a large fleshy disc. Stem hard and woody at base, 5 cm. to 10 cm. long before branching, gradually narrower, less terete, and more distinctly winged upwards, passing into a linear, much divided frond. Full

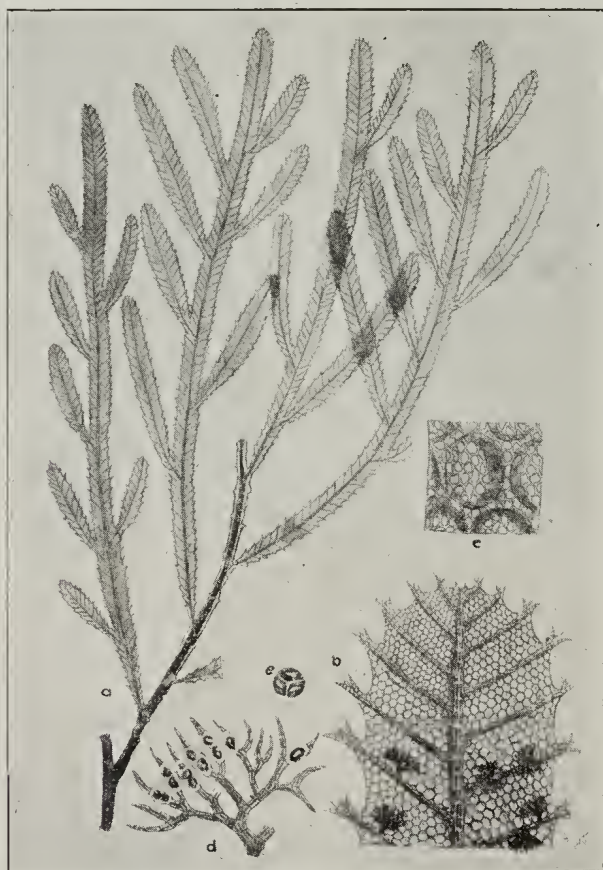


Fig. 127.—*Dictymenia Sonderi*: a, plant; b, apex of a segment, showing midrib, veinlets, false areolations and shrubby stichidia; c, small portion of same showing surface cellules and medullary cells appearing through; d, branch from a decompound stichidium; e, tetraspore from same. (After Harvey.)

grown plant 30 em. to 50 em. long. All the divisions of the frond issue at acute angles, strictly linear, and rounded at the top. The older ones strongly, the younger ones faintly midribbed, the midrib is pinnated with slender veins, which proceed to the margin, and are excurrent into the marginal tooth-like processes; these latter are commonly trifid. The stichidia spring from the lateral veins of the segments, or from the midrib, and are excessively branched; they bear tetraspores singly or in pairs in the swollen upper divisions. Substance rigid. Colour dull red-brown. This species is closely allied to *D. tridens*, but is a larger and stronger growing plant.

Western Australia (Garden Island, Fremantle).

Dictymenia interstincta J. Agardh.

Frond smooth articulate, alternately pinnate, and irregular, with linear pinnellae. Midrib strong, and wider at the base, with smaller ribs running out to the linear pinnellae, interspersed with small teeth; above fertile, narrow, linear, without ribs, somewhat irregular. Stichidia developed from the margin of the denuded pinnellae; subcorymbose. Substance gelatinous, membranaceous. Adheres to paper, dark-brown red.

South Coast of Australia.

Dictymenia tridens (Mert.) Greville.

Frond 15 em. to 30 em. long, from less than 2 mm. to 6 mm. in breadth, flat and membranaceous, linear, narrowed to the base and apex, furnished in the lower part with a strong midrib, which gradually becomes thinner and fainter upwards, and disappears below the apex, simple or divided into three



Fig. 128.—*Dictymenia tridens*.

or four principal branches. Main branches bi-tripinnate, ovate in circumscription; pinnae closely set, erecto-patent, alternate; pinnules similar, gradually shorter towards the apices; the margin in every part of the frond, except the denuded bases of old stems, furnished with minute, forked, trifid or four to six-fid ramuli, about 2 mm. long, subulate, transversely striate; colour dark reddish-brown when dry. Cystocarps ovate-globose, wide-mouthed, sessile, on the sides of the marginal teeth. Stichidia distorted or forked, formed from the marginal teeth, which are then very much developed and multifid. This species varies very much in width.

South Australia (Encounter Bay, LeFevre Peninsula, Investigator Strait, Eastern Bays), Western Australia, Victoria, Tasmania.

Dictymenia angusta J. Agardh.

Frond 18 cm. to 25 cm. high, areolate, with narrow linear pinnae; pinnellae conspicuous, irregular, alternate. The pinnae in the young plant are somewhat fan-shaped, in the fully developed plant are more or less uneven; the ends of the pinnellae are strongly penicillate, and subcorymbose; the adult pinnellae alternately pinnatifid. Substance membranaceous.

South Australia (Eastern Bays, Encounter Bay).

Dictymenia spinulosa Kützinger.

Frond slender, branched at the base, rami long, longitudinally ribbed, winged, margin irregularly toothed; at the apex tri-pinnatifid, and pyramidal. The pinnellae narrow and spinose, fertile. Cystocarps globose, sessile. Substance rigid.

South Coast of Australia.

Dictymenia Harveyana Sonder.

Frond 12 cm. to 30 cm. long, to 2 mm. broad, gelatinous-membranous; areolae obsolete; alternate or irregularly pinnate, the margin in every part furnished with minute, forked, trifid or four to five-fid ramuli, about 2 mm.



Fig. 129.—*Dictymenia Harveyana*: a, plant; b, part of a frond, enlarged.

long, subulate, transversely striate. Colour dark reddish or chestnut-brown. Cystocarps ovate-globose, wide-mouthed, sessile, on the sides of the marginal teeth. Stichidia eorymbose, terete, verrucose.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Tasmania, Western Australia.

Subfamily Lophothaliceae Schmitz and Falkenberg.

BRONGNIARTELLA Bory.

Fronds of radial construction, furnished with a pile of subdichotomous, spirally disposed branches. Axis polysiphonous, perieentral cells five to seven (rarely four), for a long time bare or else later covered with densely confluent rhizoids. Growth monopodial, apical cell transversely articulate. Lateral ramuli from basal cells forming a pile, transformed partly into short fruiting branches, partly into prolonged branches. Cystocarps and antheridia as in *Polysiphonia*. Tetrasporangia numerous in ramuli with or without stichidia formation, single in each articulus, disposed in linear longitudinal spirals. Diagnosed from *Polysiphonia* mainly by the pile of coloured, monosiphonous, persistent ramelli, a habit peculiar to this genus.

Brongniartella australis (Ag.) Schmitz.

= *Polysiphonia Cladostephus* Montagne.

Frond 15 cm. to 50 cm. long, about 1 mm. thick below, setaceous in the principal branches, distinctly pointed in every part, seven-tubed; the main branches naked at the base, irregularly divided, their upper part and all the lesser divisions densely whorled with single-tubed dichotomous ramelli, which spring from every joint, and are about 2 mm. in length. Cystocarps ovate, sessile on the branches at the base of the multifid ramelli. Tetrasporangia in the smaller branchlets. Colour a dull brownish-purple.

South Australia (Investigator Strait), Western Australia, Tasmania, New Zealand.

**Brongniartella Patersonis* (Sond.) De Toni.

= *Polysiphonia spinosissima* Harvey.

Frond to 15 cm. high, pinnate, irregularly branched, at the base articulate and eorticate; the ramelli very dense, almost vertical; simple and spinose below; above subdichotomous, bare at the apices. Seven to eight siphons. Tetrasporangia scattered on the rough ramelli. Cystocarps ovate, sessile.

South Australia (Investigator Strait), Victoria, Tasmania.

Brongniartella strobilifera (J. Ag.) Schmitz.

Frond terete, eorticate, pinnate, irregularly branched, the ramelli fasciculate, growing from the rachis in the adult plant; the rachis knotted below and irregularly branched above. Ramelli monosiphonous, rigid, the lower ones abrupt, the upper ones slightly curved, articulate throughout. Stichidia densely clustered, ascending spirally around the rachis, protruberant. Cystocarps ovate, subglobose, shortly pedicellate, prominent.

South Coast of Australia.

* See footnote on page 276.

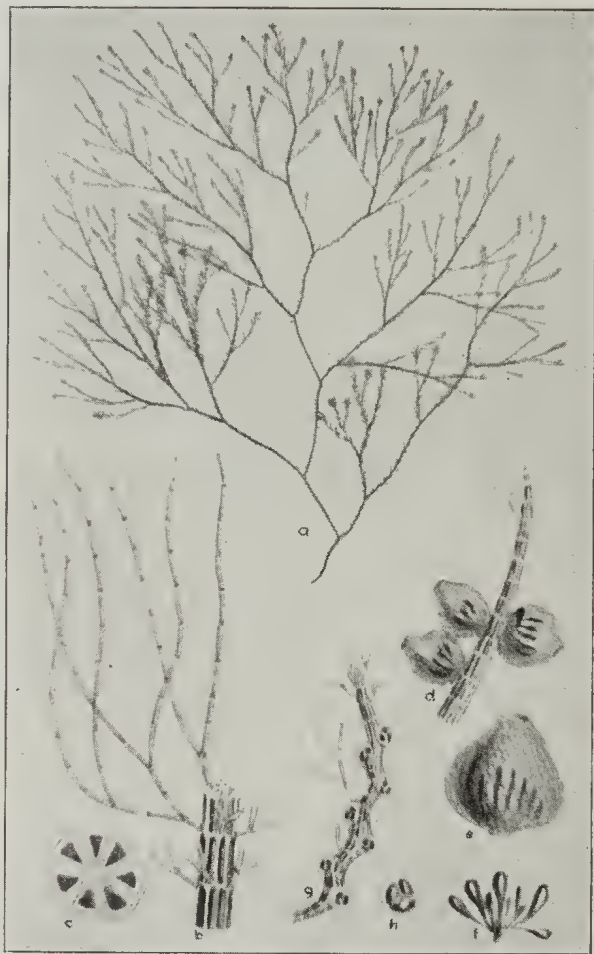


Fig. 130.—*Brongniartella australis*: *a*, plant; *b*, joints of the stem and the ramellus; *c*, cross-section of the stem; *d*, part of a ramulus, with ceramidia; *e*, a ceramidium; *f*, spores from the same; *g*, a ramulus, with tetraspores; *h*, a tetraspore. (After Harvey.)

Brongniartella sarcocaulon (Harv.) Schmitz.

Frond over 15 cm. high, 2 mm. to 4mm. in diameter, opaque and thickly coated with small cells throughout, tapering to the ends of the branches, irregularly divided, but not much branched. Pericentral cells five. Stem and branches glabrous, bare of ramelli; lesser branches sprinkled with short ramuli; ramuli patent, awl-shaped or thread-shaped, opaque, beset on all sides with very slender, minute, dichotomous ramelli, less than 2 mm. long, articulated; articulations thrice as long as broad. Colour rosy-red. Substance soft, succulent; adheres closely to paper. Stichidia containing large tetraspores, single in each articulus.

South Australia (Eastern Bays), Western Australia, Tasmania.

Brongniartella disticha Falkenberg.

Frond 2 cm. to 14 cm. long, ramuli distichous, arising from every third or fourth articulation; the ramelli monosiphonous, endochrome persisting throughout; rigid as in *B. australis*. Tetrasporangia simple in the articulations of the stichidia, disposed spirally. Colour brownish-red.

Victoria (Port Philip).

LOPHOTHALIA Kützing.

Fronds terete, polysiphonous, with five siphons surrounding a central one, corticated with rhizoids, all branches covered with long ramelli, coloured, monosiphonous and simple. Cystocarps ovate subglobose, with a cellular pericarp, osteolate; carpospores pyriform, formed in terminal articulations of filaments radiating from a basal placenta. Stichidia more or less transformed from the rachis, monosiphonous or polysiphonous; tetrasporangia two in each articulus, in subspiral order, cruciately divided, often prominent.

Lophothalia verticillata (Harv.) Kützing.

= *Dasya verticillata* Harvey.

Frond 20 cm. to 30 cm. long or more, 2 mm. in diameter below, gradually attenuated, undivided, furnished with alternate branches, the lowest of which are longest. Branches tapering to the base and apex, much more slender than the stem, twice pinnated with branchlets, the smaller of which show external signs of joints. The two last series of branches are whorled at short intervals with simple, byssoid, single-tubed ramelli, whose joints are four to eight times longer than broad, the lower joints being shortest. Substance cartilaginous, the stem imperfectly adhering to paper; the lesser branches very flaccid and tender. Colour a fine crimson-red. A transverse section of the stem shows four principal tubes surrounding a minute central cavity, and four minor intermediate ones; the spaces between being densely cellular. The stichidia are very curious and unlike those of any other genus except *D. bolbochaete*.

South Australia (Eastern Bays), Victoria, Tasmania.

Lophothalia hormoclados J. Agardh.= *Dasya hormoclados* J. Agardh.

Frond tree-like, 20 cm to 25 cm. high, 2 mm. in diameter below, thickest towards the middle, somewhat tapering to the base, and much attenuated upwards, very smooth, bare of branches for 2 cm. to 5 cm., thence to the apex bushy, with long, alternate, more or less distinctly quadrifarious branches, the lower ones 2 cm. to 3 cm. apart, the upper gradually closer, and finally much crowded. Branches three to four times compounded in an alternate pinnate manner; the larger ones opaque, the smaller ones more and more articulate, and those that produce the ramelli pellucidly jointed, their joints being as long as broad, marked with about three tubes. Ramelli simple, contracted at the base, tapering to a fine point, their upper and lower joints short, the middle ones twice or three times as long as broad, and all contracted at the dissepiments. Cystocarps urecolate, with wide mouths, shortly stalked. Colour a fine crimson, substance flaccid, adhering to paper.

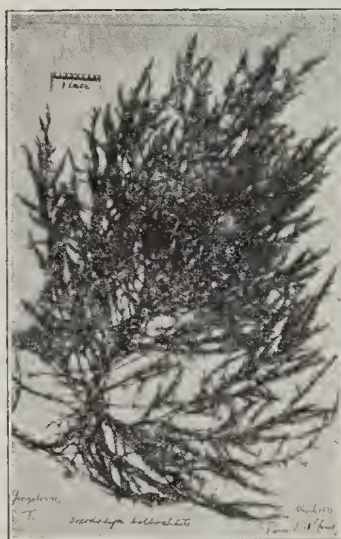
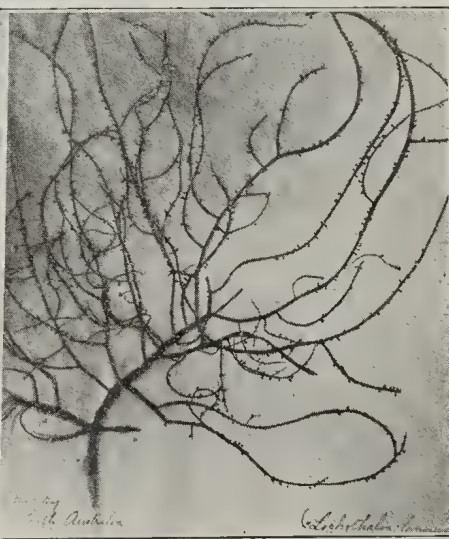
South Coast of Australia to Tasmania.

DOXODASYA Schmitz.

Fronds as in *Lothothalia*, but four pericentral cells. Ramelli monosiphonous, repeatedly divided, spirally or inordinately disposed, sometimes densely congested. Stichidia pedicellate, polysiphonous, rarely monosiphonous. Cystocarps evolved from secondary articulations of the branches, short, mostly simple, supported on a monosiphonous pedicel.

Doxodasya bolbochaete (Harv.) Falkenberg.= *Dasya bolbochaete* Harvey.

Frond 15 cm. to 35 cm. long, or more, three or four times branched in an alternate manner, the larger and smaller branches all virgate, long, simple and straight, densely clothed with pencilled, simple ramelli, 4 mm. to 6 mm.

Fig. 131.—*Doxodasya Bolbochaete*.Fig. 132.—*Doxodasya lanuginosa*.

in length, which spring from minute bulb-like ramuli, disposed quadri-fariously on the stem, at distances of from 1 mm. to 2 mm. apart. These bulb-like ramuli are eventually, in fertile specimens, changed into stichidia, merely becoming larger without alteration of form or loss of their ramelli. They are sometimes solitary, but more frequently tufted. A transverse section of the stem shows four large tubes surrounded by a thick and dense cellular periphery.

Victoria (Western Port), Tasmania (Georgetown).

Doxodasya lanuginosa (J. Ag.) Falkenberg.

Frond 20 cm. to 30 cm. long, terete, ramuli pinnate, slender, more or less irregular, corticate. In young specimens the ramelli are monosiphonous, very setaceous; most branches bearing stichidia are denuded, those bearing cystocarps are almost denuded. Stichidia found towards the lower end of the ramelli, developed on the rachis; these stichidia are themselves polysiphonous, sub-lanceolate, bare, carrying tetrasporangia scattered in the articulations. Cystocarps subglobose, urceolate; the pericarp solid, opaque.

South Australia (Encounter Bay, Eastern Bays).

Doxodasya Lenormandiana (J. Ag.) Schmitz.

= *Dasya Lenormandiana* C. Agardh.

Frond about 30 cm. long, terete, corticate, widely branched, pinnate; stem and large ramuli naked below, the apices and smaller ramuli irregularly branched; ramelli spreading from the cortex are polysiphonous below, monosiphonous above, irregularly pinnate, rigid. Stichidia developed from the scarcely changed ramelli, polysiphonous and ecorticate, verrucose. Tetraspores spirally arranged.

Victoria (mouth of Glenelg River).

Subfamily Polyzonieae Schmitz.

EUZONIELLA Falkenberg.

Branches long, affixed to matrix by a radical disc, totally ecorticate and not winged. Branches bearing short unilateral ramuli, free or conerescant together. Tetrasporangia in long pod-like, subineurved ramuli, single in each segment and in series. Cystocarps evolved on lower, lateral pinnules of ramuli or at bases of ramuli, ovoid, sessile.

Euzoniella incisa (J. Ag.) Falkenberg.

= *Polyzonia incisa* J. Agardh.

Primary frond prostrate, rooting at the nodes, creeping over other algae. From this there rise several erect stems, 1 cm. to 3 cm. long, simple or alternately pinnate, articulate; the articulations scarcely so long as broad, composed of six cells surrounding a central cavity. Ramuli alternate, horizontally patent or somewhat recurved, pectinate on the upper side; the laciniae four or five, somewhat lanceolate, tessellated with three rows of hexagonal, oblong cells. Cystocarps broadly ovate, subsessile, formed from the

lowest segment of the fertile ramulus, and thus nearly in the axil; the pericarp areolated, thin, and containing a dense tuft of pyriform spores. Stichidia lanceolate, suberect, supra-axillary, more or less crested at the summit, containing a single row of large tripartite tetraspores. Colour a deep full red, becoming brighter in fresh water. Plants adhere to paper in drying.

South Australia (Investigator Strait), Victoria, Tasmania, New Zealand.

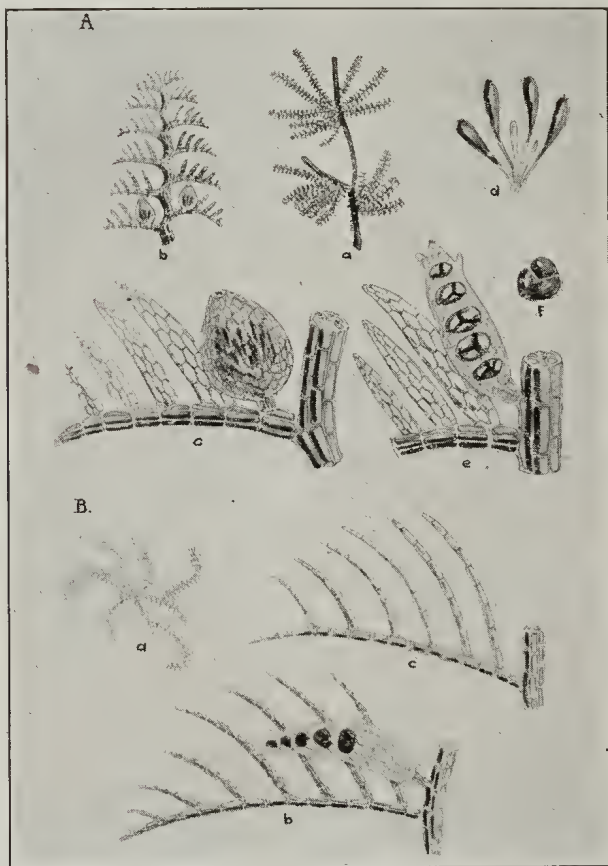


Fig. 133 (upper).—*Euzoniella incisa*: a, plant; b, tip of a fertile branch, with distichous, pectinate ramuli, two of which have ceramidia; c, a ramulus and ceramidium; d, spores; e, part of a ramulus and stichidium; f, a tetraspore. (After Harvey.)

Fig. 134 (lower).—*Euzoniella flaccida*: a, plant; b, a ramulus, with its superposed stichidium; c, a ramulus with monosiphonous lacinulae. (After Harvey.)

Euzoniella flaccida (Harv.) Falkenberg.

= *Polyzonia flaccida* Harvey.

Very closely allied to *E. incisa*, but much more slender, of softer and more flaccid substance. Primary sureculus creeping; stems erect, arching, simple or branched, very slender, flaccid; ramuli pectinato-partite on the upper edge, laciniae 5-6, filiform, acute articulate, mono-di-siphonous. Stichidia very patent, and their apex is prolonged into a sort of peak. Colour crimson-red.

West Australia (Fremantle, King George Sound), Victoria.

POLYZONIA Suhr.

Attachment a callous disc; frond often dwarf, pinnate, branched: branches long, the lower ones creeping, with clearly defined wings or keel rising from the ventral surface; wings and keel composed of many cells, secund, proliferous, with a definite margin, subcostate, transversely zoned, with cauliform polysiphonous ramelli above the axils. Fruit solitary above the axils. Cystocarps ovate, opening through the carpostomium of the pericarp. The carpospores are pyriform, in the terminal articulations of the filaments. Stichidia filiform, whorled. Tetrasporangia arranged in straight, longitudinal rows. Antheridia sub lanceolate, composed of minute spores.

Polyzonia elegans Suhr.

Frond sparsely branched, ramuli alternately pinnate, phyllodia secund, with a semi-ovate circumference, with the lower edge straight, entire; the upper edge with three or four strongly marked serrations, transversely zoned with a central vein. Stichidia developed on the concave side of the ramuli, crested or tufted.

South Coast of Australia, South Africa.

CLIFTONAEA Harvey.

Frond stipitate, formed of secundly proliferous, halved, pectinate phyllodia. Phyllodia costate, with diverse sides; one side flat, areolate, membranous, very entire; the other pectinato-partite.

Cliftonaea pectinata Harvey.

Frond 5 cm. to 14 cm. long, irregular, phyllodia sometimes membranous, entire; sometimes the secondary phyllodia are filiform, subulate, 1 cm. to 3 cm. wide. Stichidia borne on the midrib, or the concave side of the secondary phyllodia, carrying tetrasporangia. Colour bright-red, adheres imperfectly to paper.

South Australia (Kangaroo Island (north coast)), West Australia (Garden Island).

Cliftonaea semipennata (Lamour.) J. Agardh.

Phyllodia scimitar-shaped, semipinnate, their laciniae cultrate, flat, toothed on the lower margin, shorter than the breadth of the lamina. Stem 2 cm. to 5 cm. long, coriaceous, rigid when dry, arched, naked, or more or less fringed on the concave side. Phyllodia numerous, springing from the convex side of the stem, 5 cm. to 10 cm. long, scimitar-shaped, the older ones with a valid costa, the younger with a very slender one. The outer or convex side of the phyllodium is winged with a semi-lanceolate, transversely striate, delicately membranous lamina, composed of oblong, hexagonal cellules, set in rows. The internal side is closely pinnulated with a double row of cultrate laciniae; these are flat and leaf-like, and composed of oblong cellules; they are nearly straight and entire on the upper margin, curved and denticulate on the lower; shaped like a coulter. Colour crimson to purple, substance membranous, rather rigid, adheres imperfectly to paper.

South Australia (Sturt Bay, Encounter Bay).

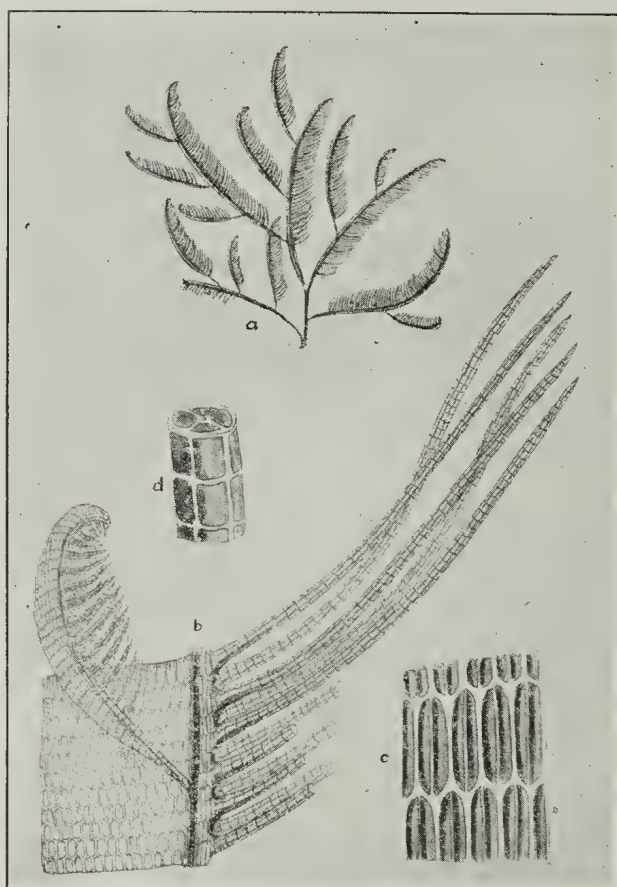


Fig. 135.—*Cliftonia pectinata*: *a*, plant; *b*, fragment of a phylloodium, with a young one starting from its midrib; *c*, some of the cellular tissue from the lamina; *d*, frustule of one of the pectinate ramelli. (After Harvey.)

Subfamily Herposiphonieae Schmitz and Falkenberg.

DIPTEROSIPHONIA Schmitz and Falkenberg.

Frond creeping, shield-shaped, apex erect, terete, ecorticate for some distance, with five or more central siphons; pinnately branched, the pinnae dichotomous, the long wings simple or branched, apices straight, shorter wings simple, alternately branching from the rachis. Tetrasporangia mainly on the shorter pinnae or the simple long ones, arranged on the convex side in a simple straight row, or a slightly broken one. Antheridia on the short pinnae, short, cylindrical, pedicellate. Cystocarps ovoid, sessile on the wings, single or in pairs.

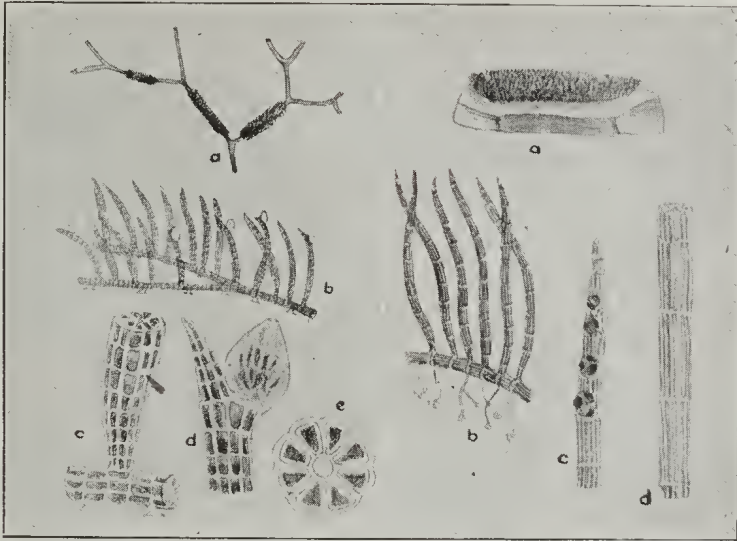


Fig. 136.—*Herposiphonia prorepens*: a, part of a frond of *Dicranema Grevillei*, with *Herposiphonia prorepens* growing on it; b, creeping branch and ramuli of *H. prorepens*; c, base of ramulus and part of creeping stem; d, apex of ramulus, with a ceramidium; e, cross-section. (After Harvey.)

Fig. 137.—*Lophosiphonia Calothrix*: a, patch of *L. Calothrix* on a piece of rock; b, part of the creeping frond, and erect ramuli; c, apex; d, middle portion of a ramulus. (After Harvey.)

Dipterosiphonia dendritica (J. Ag.) Falkenberg.

= *Polysiphonia dendritica* J. Agardh.

Frond dwarf, 5 cm. long, wholly prostrate, distichous, pinnate, irregular, pinnae dichotomous, alternate, the lower ones simple, subulate; the upper ones more or less irregular, articulate, with five siphons. Tetrasporangia as above. Cystocarps long, pedicellate, ovate. Substance soft, adheres to paper.

Victoria (Port Phillip), New Zealand, Brazil.

Dipterosiphonia prorepens (Ag.) Falkenberg.

= *Polysiphonia prorepens* J. Agardh.

Frond filiform, dwarf, 5 cm. or more long, the primary filaments prostrate, subdistichous, pinnate, secondary ones rising almost vertically, secund, alternate. Pinnae regular, pinnellae simple, subulate, obtuse, alternate, articulate, six to eight siphons. Tetrasporangia unevenly scattered on the pinnellae.

Western Australia (King George Sound), South Africa.

HERPOSIPHONIA Naegeli.

Fronds rooting, apices shield-shaped, ecorticate, ascending from a horizontal sureculus or rarely all erect, laterally branched, terete, complanate or two-edged and compressed. Long and short segments distinct; longer with dorsiventral structure, apices involute, emitting lateral, distichous, alternate, elongate branches; shorter uni- or bi-seriate, giving off long segments from dorsal region, radial or dorsiventral structure, apices penicillate but deciduous. Pericentral siphons numerous, 12 to 18. Tetrasporangia evolved in median region of ramuli, in a single series more or less irregularly interrupted or regularly disposed. Cystocarps ovate or globose, carpospores aerogenous, clavate. Antheridia on apices of ramuli, borne on monosiphonous pedicels.

Herposiphonia rostrata (Sond.) Falkenberg.

Fronds rising from prostrate sureculi, 2 cm. to 7 cm. long, attached to other algae by small adhesive discs. Fronds 2 cm. to 5 cm. high, capillary, sub-simple, linear or lanceolate in outline, set throughout with short, simple, erecto-patent, falcato-incurved, alternate branches, each subtended by several scattered, subsecund or spirally inserted, simple, filiform ramuli. Branches pectinated along their lower (outer) side with similar secund simple ramuli, one from nearly every node. Articulations as long as broad in all parts, those of main stem having 12 to 16 tubes, fewer in the ramuli. Cystocarps ovate, terminating a shortened ramulus. Tetraspores lodged towards the base of the ramulus, the fertile portion tipped with a beak-like barren point. Colour dark purplish-red.

South Australia (Investigator Strait, Eastern Bays), Western Australia.

Herposiphonia pectinella (Harv.) Falkenberg.

= *Polysiphonia pectinella* Harvey.

Frond dwarf, arachnoid with prostrate filaments springing from the base, irregularly branched; ramelli shorter and pectinate, slightly curved at the apices, vertical, secund, slender, glabrous; articulate, about eight siphons. Colour when dry reddish-purple. Adheres to paper.

West Australia (King George Sound).

Herposiphonia versicolor (Hook. f. and Harv.) Falkenberg.

= *Polysiphonia versicolor* Hooker f. and Harvey.

Fronds densely tufted, rising from creeping filaments, erect, 5 cm. to 10 cm. high, setaceous below, very fine above, much branched. Stem subsimple, furnished throughout with decompound, lateral, nearly horizontal, subdistichous branches. Ramuli subulate, simple, alternate or frequently secund, 4 mm. to 6 mm. long. Articulations one and a half times as long as broad, containing about ten tubes surrounding a central cavity. Colour a fine crimson, quickly changing in fresh water to golden-orange. Cystocarps ovate, sessile near the apex of the ramuli.

South Australia (Investigator Strait, Eastern Bays), Western Australia to Tasmania.

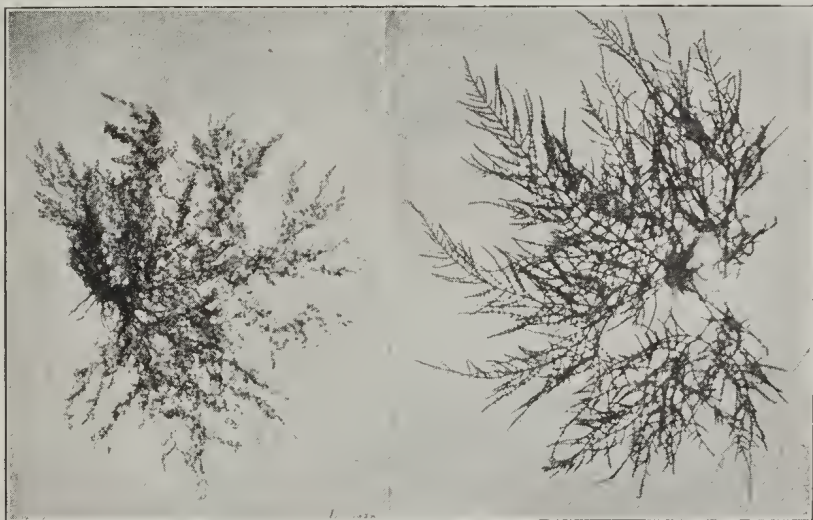


Fig. 138.—*Herposiphonia versicolor*.

Fig. 139.—*Protokutzgingia australasica*.

Herposiphonia prorrepens (Harv.) Schmitz.

= *Polysiphonia prorrepens* Harvey.

Frond from $\frac{1}{2}$ cm. to 3 cm. or more long, lying flat on the surface of the coralline to which it is attached at intervals by little discs which issue from the under surface; vaguely branched, jointed throughout, compressed laterally. From the upper side of nearly every joint springs a perfectly simple, falcate ramulus, about 2 mm. in length, acute, constricted at the base, jointed, and strongly compressed. Joints of the creeping filaments rather shorter than their breadth, of the ramuli twice or three times as short, all about 12 tubed. Tetrasporangia immersed in the slightly distorted ramuli, in a single row.

South Australia (Holdfast Bay), West Australia (King George Sound), South Africa.

Herposiphonia filipendula (Harv.) Falkenberg.

= *Polysiphonia filipendula* Harvey.

Frond very small, 5 cm. or less; long primary frond prostrate, irregularly branched, ramelli shorter and pectinate, at the apices slightly curved inwards, vertical ramelli secund and slender, adult ones longer, finally branched; articulate, with ten siphons. Colour red, adheres to paper.

West Australia, Victoria.

HERPOPTEROS Falkenberg.

Frond dorsiventral, creeping, with irregular rhizines below, regular, laterally branched; six-nine central cells, for a long distance devoid of cortex. The principal ramuli (sometimes complex, sometimes simple) divide laterally into alternately long and short ramuli. Stichidia situated in the simple apices of the lateral branches. Tetrasporangia is slightly curved rows on the dorsal surface of the stichidia. Cystocarps globose.

Herpopteros fallax Falkenberg.

The only species, with the characters of the genus.

Victoria (Port Phillip, Western Port), Tasmania.

LOPHOSIPHONIA Falkenberg.

Attachment a disc. Frond creeping, terete, laterally branched, all ramuli dorsiventral, with the apices first curled then straight; ramuli long, prostrate, endogenous; lateral ramuli especially long, with rows of shorter ramelli issuing fairly regularly from the dorsum. The shorter ramuli are undivided, with penicillate apices. Axis very polysiphonous, central cells often numerous, no cortex. Tetrasporangia numerous on the lower or middle part of the short ramelli, arranged in straight rows along the dorsum, or in broken irregular rows.

Lophosiphonia ? neglecta (Harv.) De Toni.

= *Polysiphonia neglecta* Harvey.

Frond about 5 cm. long, very caespitose, spreading over rocks; primary filaments prostrate, secondary ones rising vertically, thinly branched above; ramuli erect; articulate. Eight to nine siphoned. Tetrasporangia few on the almost unchanged ramelli.

West Australia (King George Sound), New Zealand.

Lophosiphonia calothrix (Harv.) De Toni.

= *Polysiphonia calothrix* Harvey.

Frond caespitose, small, dense, growing on rocks; primary filaments prostrate, branched; secondary ones more slender, vertical, simple, arranged alternately, glabrous. Articulate 10-12 siphoned. Tetraspores sparse on the thick vertical filaments.

West Australia (King George Sound).

opposite each other. Stiehidia carried on the semi-concave inner margin of the frond, 8 mm. to 12 mm. long, whorled, sublanecolate, curled. Colour brownish-red. Substance membranaceous, adheres to paper.

South Australia (Investigator Strait, Eastern Bays), Western Australia, Tasmania.

AMANSIA Lamouroux.

Frond flat, midribbed, pinnatifid or proliferous, transversely striate, membranous; the membrane formed of hexagonal cells, of equal length, arranged in obliquely transverse lines or striae, destitute of cortical cellules. Cystocarps ovate or globose, containing a tuft of pear-shaped spores. Stiehidia simple or branched, marginal or superficial, containing tetraspores in a double row.

Amansia Kützingerioides Harvey.

Frond much branched. Stem cartilaginous, 1 mm. to 2 mm. thick, opaque, destitute of bordering membrane. The lower part of the branches is similar, but the upper is bordered by a narrow, serrated, membranous wing, and closely set with horizontally patent, distichous or irregularly inserted laciniae. These laciniae are delicately membranous, traversed by a very slender midrib, obliquely transversely striate, and more or less deeply pinnatifid; the younger ones are simply serrate, the older incised, and the fully developed regularly pinnatifid; the outline is oblong or obovate. The pinnules, or ultimate segments, are about 2 mm. broad and sharply serrate, minutely bifid, and quite straight (not involute) at the apex. Under the microscope the membrane is shown to be composed of hexagonal cells, about four times as long as broad, symmetrical and of equal size and separated by pellucid lines. The stiehidia are scattered on the surface of the lamina, tufted, linear-attenuate, hooked over at the point, and contain a double row of tetrasporangia. The colour is brownish-red. Substance is rigid and membranous, and the plant does not adhere to paper in drying.

South Australia (Holdfast Bay, Encounter Bay), West Australia.

Amansia pinnatifida Harvey.

Frond 15 cm. to 50 cm. long, and as much in the expansion of the branches, linear in every part, from 2 mm. to 3 mm. wide, several times distichously pinnatifid. Branches alternate or secund, their pinnae and pinnules 4 mm. to 6 mm. apart, erecto-patent, narrowed at base, with inflexed margins and inrolled obtuse apices, traversed by a very slender, unicellular, articulated midrib. The membrane is composed of a single plate of elongated, hexagonal, longitudinal cellules, arranged in transverse zones across the lamina; these zones are alternately different, the cells in one zone diminishing in length from the costa to the margin, those in the other diminishing from the margin to the costa. The colour is a deep purplish brown-red. The substance is firmly membranous and rigid, but thin and in drying does not adhere to paper.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia (King George Sound).



Fig. 140.—*Amansia Kutzingioides*: *a*, plant; *b*, a pinnule, bearing tufts of stichidia; *c*, portion of the membrane, to show the hexagonal cells of which it is composed; *d*, a tuft of stichidia; *e*, a tetraspore. (After Harvey.)

ENANTIOCLADIA Falkenberg.

Frond erect, margins all more or less winged and very regular; axis polysiphonous, composed of cells around five central siphons, the cortex thick and formed of minute cellules. Primary ramuli long, regular, apices curled, branched laterally, dichotomous; the ramelli often secund, simple and denticulate, rising from the ventral and dorsal part of the frond or from the surface of the marginal teeth singly or in groups. Cystocarps subglobose, pericarp very thick. Tetrasporangia numerous in the stichidia. Stichidia mostly crowded on end of the ramuli.

Enantiocladia axillaris Falkenberg.

Primary frond thick, costate, denuded of wings, as if stipitate; ramuli lateral, slender, simple. Tetrasporangia sometimes on the apices of the branches, other times carried in the stichidia. Stichidia grouped in the axils of the ramuli. Colour red.

West Australia (King George Sound).

VIDALIA Lamouroux.

Fronds erect, compressed, often spirally twisted, serrated, irregularly pinnate; much branched, ribs immersed with veins running out into the serrations; obliquely transversely zonate. The interior cells arranged in two parallel rows, forming long hexagonal zones, ascending obliquely from the costa; the outer cortical cells very minute and densely packed: five central siphons. Fruit developed on the margins of the serrations or the much changed ramelli. Cystocarps subglobose. Carpospores pyriform in the terminal articulations of the filaments. Antheridia subglobose, in rows on the convex side of the serrations. Stichidia fasciculate, regular, lanceolate, linear, curved. Tetrasporangia in two longitudinal rows. Colour red; substance cartilaginous.

Vidalia spiralis Lamouroux.

Frond 15 cm. to 20 cm. long, branched, irregularly curved or spirally twisted, 4 mm. to 6 mm. in diameter, tough and hard, corrugated, obscurely winged, densely clothed throughout with lateral branches. Branches membranaceous, thin, 10 cm. to 20 cm. long, 3 mm. to 7 mm. broad, preserving nearly the same breadth throughout, rather narrow at the apex, pinnatifid or bipinnatifid; the laciniae very erect, linear, spirally twisted, sharply serrate, the serratures about 2 mm. apart, with rounded interstices. Stichidia forming interrupted lines upon the costa, very dense, lanceolate, involute, containing a double row of tetraspores. Cystocarps globose, pedicellate, issuing from the costa, or more frequently terminating the marginal teeth. Colour reddish-brown when dry.

South Australia (Holdfast Bay, Encounter Bay, Investigator Strait, Spencer Gulf). Western Australia.

OSMUNDARIA Lamouroux.

Frond proliferous. Phyllodia flat, linear, midribbed, very rough on both sides with wart-like or spine-like processes; interior cellules large and

empty; exterior minute, coloured. Stichidia lanceolate, involute, scattered or tufted, containing a double row of tetraspores. Cystocarps globose, stalked, grouped terminally on the phyllodia.

Osmundaria prolifera Lamouroux.

= *Polyphacum proliferum* Agardh.

Attachment or holdfast an expanded callus. Stem in old fronds 2 cm. to 5 cm. or more long, cylindrical below, rigid and ligneous, becoming



Fig. 141.—*Osmundaria prolifera*: a, plant; b, fragment of a leaf-bearing specimen; c, portion of a leaf; d, cross-section of leaf; e, portion of apex of fertile phyllodium, with tufts of stichidia; f, stichidium; g, tetraspore. (After Harvey.)

compressed upwards and passing into the tapering base of a narrow-linear, thick, coriaceous, opaque, very obtuse phyllodium, which is 6 cm. to 15 cm. long and generally about 1 cm. wide. From the midrib, and often from the apex of the primary phyllodium, spring others of similar form and texture; and these emit others similar to themselves but smaller; and thus, at length, a proliferously much-branched frond, 25 cm. to 50 cm. in expansion, may be formed. All the phyllodia are very closely covered on both sides with minute, spiniferous processes, giving to the surface the rough

feel of shagreen when dry. Such is the common state of the plant; but states occur in which the warted phyllodia emit perfectly smooth, thin, membranous, serrated, and transversely striate leaves. Stichidia occur in several stipitate, slightly separated, tufts, forming a crown to the phyllodia; they are lanceolate, inrolled at the point and contain a double row of tetraspores. The colour, when growing, is a very dark purple-red; when dry either brown or black. The substance is coarse, leathery when growing, rigid when dry; does not adhere to paper when dry.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia.

LENORMANDIA Sonder.

Frond leaf-like, proliferous. Phyllodia flat, membranaceous, undivided, midribbed, obliquely cross-striate, internally honeycombed with rhomboid cells; the surface cells minute. Fruit of both kinds scattered over the surface. Cystocarps ovate, pedicellate, containing pear-shaped spores. Stichidia lanceolate, containing tripartite tetraspores.

Lenormandia hypoglossum J. Agardh.

Frond 50 cm. to 75 cm. or more long, membranous, proliferous from the ribs, irregularly branched, the younger off-shoots oval, the older ones sublanceolate, linear; phyllodia flat, simple with an entire margin, the apices almost without a margin; the secondary phyllodia are fertile, caespitose, minute, arranged in rows on the costa, swelling at the end into a single cystocarp. Cystocarps ovate-urceolate, subcalcarate.

South Coast of Australia.

Lenormandia Muelleri Sonder.

Attachment or hold fast discoid. Fronds tufted, 25 cm. to 60 cm. long, proliferously much branched. In full-grown specimens there is a cartilaginous, terete stem, about 1 mm. thick and 2 cm. to 5 cm. in length; this gradually becomes two-edged and then winged upwards, dividing (proliferously) into two to four or more principal branches, which are bordered with a narrow wing and traversed by a thick midrib. These main branches are 12 cm. to 25 cm. long and quite simple, being formed out of a partly denuded phyllodium of a former season; they emit from their midrib numerous phyllodia, varying much in size. The phyllodia are 5 cm. to 10 cm. long, about 3 cm. wide, oblong, very obtuse or emarginate, tapering at base into short stipe or petiole, delicately membranous, traversed by a very slender and often scarcely visible costa, and sprinkled with minute rough points. Cystocarps of an ovate form are often scattered over both surfaces of the frond, being developed out of the rough points; they contain a tuft of narrow pear-shaped spores and paranemata. The surface of the frond, under a pocket lens, appears decussated with oblique lines, which divide the membrane into lozenge-shaped areolae, indicative of the large, obliquely seriated, rhomboid cells which constitute the central substance of the phyllodia. The surface cellules are very minute and in several

rows. The colour is brownish-purple, becoming much browner or even blackish in drying. The substance is firmly membranous; and the plant shrinks and adheres imperfectly to paper. This handsome plant is very closely related to the *L. spectabilis* of West Australia, from which it chiefly differs in having a more decidedly caulescent frond, with more strongly ribbed phyllodia.

South Australia (Encounter Bay, Eastern Bays), Victoria, Tasmania.



Fig. 142.—*Lenormandia Muelleri*: a, plant; b, portion of a phyllodium; c, section of a phyllodium; d, a ceramidium; e, spores and paranemata. (After Harvey.)

Lenormandia spectabilis Sonder.

= *Lenormandia latifolia* Harvey.

Attachment or holdfast a small disc. Frond originating in, or wholly consisting of, an oblong lamina, transversed by a very slender midrib, which becomes fainter upwards; very variable in breadth, being from 2 cm. wide in the narrowest, 10 cm. to 15 cm. wide in the broadest specimens. From the primary leaf there issue proliferously, either from its disc or margin, numerous similar fronds, and these bear others with similar irregularity, and thus a very compound and often densely imbricated frond is

produced. All the older leaves and leaflets are more or less thickly mucated with minute ciliary processes, giving a rough feel to the surface. In the broader varieties the nerve is very faint, and sometimes disappears altogether; in the narrow or more compound it can usually be traced quite to the apex. Fruits of both kinds are scattered over the surface; the cystocarps being solitary, and the stichidia collected in little tufts. The cystocarps are ovate, shortly stipitate, with thick, cellular walls, and they contain a tuft of pear-shaped spores. The stichidia are narrow-obovate or spatulate, and contain a few tetraspores, in a double or single row. The colour is a deep purplish-red, turning brown in drying. The substance is rather rigidly membranous. The young frond scarcely adheres to paper in drying.

This is the original species upon which the genus *Lenormandia* was founded, but owing to its extreme variability, it is possible that *L. Muelleri* is merely one of its extremely divaricated forms. The Tasmanian *L. marginata*, is a very well-marked species, and not to be confused with the former, or the New Zealand form *L. chauvinii*.

South Australia (Pennington Bay (Kangaroo Island)), West Australia.

Lenormandia pardalis J. Agardh.

Frond membranaceous, proliferous from the margin, or near the costa, irregularly branched; the secondary phyllodia subovate when young, lanceolate-oblong, apices round, margin entire. Stichidia elliptical, a few (three to six) grouped in minute fascicles, forming almost longitudinal lines, sessile. The primary phyllodia 15 cm. to 25 cm. long, 2 mm. to 4 mm. wide. Secondary phyllodia 10 cm. to 20 cm. long.

South Australia (Encounter Bay).

Lenormandia prolifera (Ag.) J. Agardh.

= *Rytiphloea simplicifolia* Harvey.

Frond compressed or terete, dendroid, pinnate, transversely striate, corticated; the axis articulated, composed of a circle of large oblong cells surrounding a central cell; the periphery of several rows of small, angular, mostly coloured cells. Cystocarps ovate, containing a tuft of pear-shaped spores. Stichidia containing tripartite tetraspores.

Attachment discoid. Primary leaf from 2 cm. to 15 cm. long, from 2 mm. to 6 mm. wide, quite flat or slightly hollow on one side, very obtuse, tapering at base into a short stipe, traversed by a slender midrib, from which numerous similar leaves, one to three or more inches in length, are thrown out proliferously without any definite order. These, in like manner, bear a third, and those a fourth series of similar leaves, until there results (in old specimens) a bushy, much compounded frond, made up of simple, linear leaflets. All the leaflets are of similar shape; their apices are minutely inflexed or involute; the margin minutely raised towards one surface; the membrane is thickish, opaque, not glossy, and appears under a pocket lens as if delicately and very closely transversely striate. Stichidia linear-lanceolate, acute, inflexed or involute, closely placed or tufted along the

midribs of the leaflets, containing tetrasporangia in a double row. The colour is a dark brownish-red, becoming darker in drying. The substance is coriaceous and tough, and in drying scarcely adheres to paper.

Victoria, Tasmania.

Lenormandia Smithiae (Hook f. and Harv.) Falkenberg
= *Polyphacum Smithiae* Hooker f. and Harvey.

Frond originating in a narrow, undivided, primary leaf, 10 cm. to 15 cm. long, and scarcely 5 mm. in breadth, of a membranaceous or subcoriaceous, thickish substance, tough and not adhering to paper, tapering at the base, but very blunt and subemarginate at the apex, traversed by an internal rib,

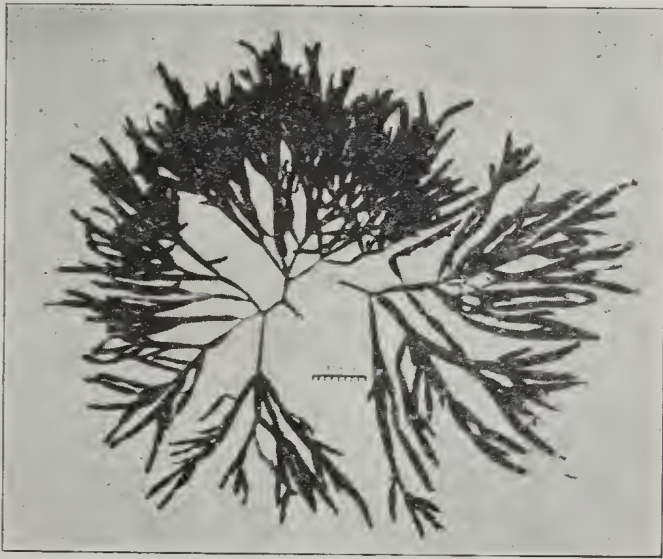


Fig. 143.—*Lenormandia Smithiae*.

and having its surface on both sides densely asperated with minute, lanceolate ramenta, 2 mm. or less in length, with involute tips. This primary leaf throws off, from various parts of its midrib, leaves similar to itself, 5 cm. to 8 cm. long, and 4 mm. to 6 mm. wide, clothed in like manner with ramenta; and these also produce other phyllodia. In old specimens the primary leaf is converted into a stout, winged, woody stem; and many of the ramenta are more or less compound. Stichidia compound, scattered along the disc of the phyllodium, generally near the margin, pedicellate, very much branched in a corymbose manner, the corymb with three or four primary branches each of which produces several distichous, secondary stichidia, strongly involute or circinate, containing a double row of tetrasporangia, and bearing other proliferous, minute stichidia from their inner faces. Colour, when dry, reddish-brown.

South Australia (Pennington Bay (Kangaroo Island)), Tasmania.

Lenormandia marginata Hook. fil et Harvey.

Frond 15 cm. to 25 cm. long and as much in the expansion of the pro-liferous phyllodia. Primary phyllodia 6 cm. to 12 cm. long, 1 cm. to 2 cm. wide, obtuse at each end, oblong, emarginate at the extremity, traversed by a very slender (sometimes obsolete) midrib, and bordered with abundant ciliary processes, rarely absent. Secondary and tertiary phyllodia spring from the margins; in older fronds many more arise from the disc and spread in all directions. Surface of disc or phyllodia commonly smooth and naked, marked with faint decussating lines; occasionally bearing processes. Fruits marginal, occasionally on the disc. Cystocarps ovate, shortly pedicellate, opaque, with thick walls, containing a tuft of narrow-pyriform spores. Stichidia linear-lanceolate, acute, densely cellular containing a double row of tetraspores. Colour pale blood-red, darker on drying. Substance firmly membranaceous, adhering imperfectly to paper.

South Australia (Pennington Bay (Kangaroo Island), Robe), Tasmania.



Fig. 144.—*Lenormandia marginata*: a, plant; b, fragment of a leaf, with marginal ceramidia; c, section of a ceramidium; d, spores; e, fragment with marginal stichidia; f, stichidium. (After Harvey.)

Subfamily Heterocladieae Decaisne.

TRIGENEA Sonder.

Fronds terete, subcartilaginous, laterally branched, ramuli slender, densely crested; thallus cellular, ramuli polysiphonous, corticated, consisting of a central siphon surrounded by four or five concentric rows of cells, four in first row and more in outer rows, becoming smaller towards the periphery. Cystocarps sessile on the ramuli, globose, with a cellular pericarp, osteolate; carpospores pyriform, fasciculate. Tetrasporangia in subclavate ramuli, single in each articulus, triangularly divided.

Trigenea australis Sonder and Lehm.

= *Rhodomela trigenea* Harvey.

Frond 10 cm. to 20 cm. in length, cylindrical, inarticulate, cartilagineo-corneous, about 2 mm. thick, irregularly branched; the branches and stem densely clothed in every part with simple, or forked, filiform ramenta, 1 cm. to 3 cm. in length, cartilaginous and inarticulate. A transverse section of a ramulus shows a small central tube surrounded by four or five concentric rows of cells, each of which contains a bag of chromule; there are four cells in the inner row, eight in the next to it, 16 or 20 in the third, and those of fourth, which generally form the periphery, are very small and numerous. Cystocarps globose, membrano-cellular, pierced by a pore, sessile on sides of the ramenta, sometimes terminal. Colour brown-red.

South Australia (Eastern Bays), West Australia, Victoria (Glenelg river).

Trigenea umbellata J. Agardh.

Frond subumbellate, irregular; the ramuli end in an umbel, bare below; below the umbel ramelli shoot out raggedly; the ramuli of the umbel carry either cystocarps or tetrasporangia in different plants. Colour purplish-red. Substance gelatinous, adheres to paper.

South Australia (Encounter Bay, Eastern Bays), Victoria (Port Phillip).

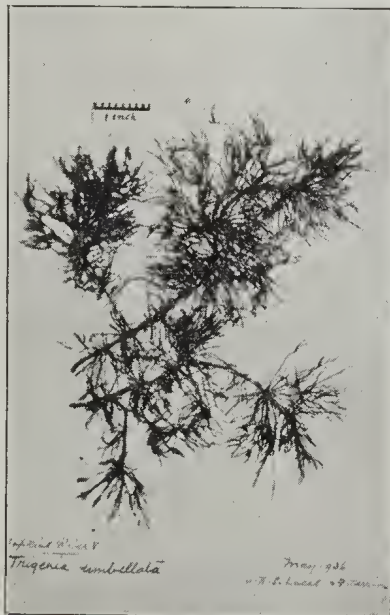


Fig. 145.—*Trigenia umbellata*.

MICROPEUCE J. Agardh.

Frond terete, pinnate, branched, the larger ramuli apparently inarticulate, the inner siphons ending unevenly; the cortex of cells closes over the ends, the smaller ramuli above emitting inarticulate monosiphoned ramelli. Cystocarps and antheridia unknown. Tetrasporangia carried on the polysiphonous apices of the ramuli, in the small cells of the stichidia, arranged spirally, triangularly divided.

Micropeuce strobiliferum J. Agardh.

Frond 6 cm. to 9 cm. long, pyramidal, the ramuli alternate, pinnate, irregular. The structure of the adult frond is strongly cellular (siphons more or less transformed). According to J. Agardh this plant closely resembles *Trigenea*.

South Australia (Port Elliot).

Subfamily Bostrychieae Falkenberg.

WILSONAEA Schmitz.

Frond radiating, slightly dorsi-ventral structure, increasingly monopodial. The ramuli long, bearing one to two rows of lateral ramelli; above, the ramuli branch everywhere alternately and end abruptly in monosiphonous apices. The central cells (five below and four above) surrounded by a parenchymal cortex. Stichidia cylindrical, slightly curved, fertile on the sides and dorsum, polysiphonous, shortly pedicellate, apices often monosiphonous, coronate with minute cortical cellules. Tetrasporangia verticillate.

Wilsonaea dictyroides (J. Ag.) Schmitz.

= *Dasya dictyroides* J. Agardh.

Frond 9-14 cm. long, terete, pinnately branched, ramelli dense at the apices, sub-squarrose, covering the upper part of the rachis, the lower ones longer and curved in. Stichidia prominent, wide at the base, sessile, conical, fertile in the articulations.

South Coast of Australia.

BOSTRYCHIA Montagne.

Frond filiform, pinnately branched, inarticulate, tessellated with quadrate or hexagonal cells; axis tubular, articulated, surrounded by one or more concentric rows of coloured cells. Ramuli hook-pointed. Cystocarps terminal, ovate, containing a tuft of pear-shaped spores. Stichidia terminal, fusiform, containing a double row of tetraspores.

Bostrychia simpliciuscula Harvey.

= *Bostrychia rivularis* Harvey.

Frond caespitose, intricate, widely spreading, the attachment filaments elongate, monosiphonous; the filaments of the frond are ecorticate, the primary ones prostrate, widely branched, the secondary ones erect, simple, or sparsely branched, very elongate and attenuated at the upright apices; polysiphonous. Fruit unknown. Colour dirty red.

Victoria (Port Fairy), Friendly Islands.

Bostrychia Harveyi Montagne.

Fronds densely tufted, spreading in patches over sticks and straws accidentally submerged, 4 cm. to 5 cm. high, less than $\frac{1}{2}$ mm. thick, bi-tripinnated. The principal stem or branches are angularly flexuous or zigzag; all are dotted with minute surface cellules, and a cross-section shows them to be composed of several rows of hexagonal cells, each containing a bag of dark-purple endochrome. Pinnæ alternate, variable in length, long and short intermixed, patent, once or twice compounded. The pinnules also vary in degree of composition; the lowest are often quite simple, those next in order bifid or trifid, and the uppermost frequently multifid or dichotomous. The apices are strongly inrolled. Colour deep purple; substance cartilaginous, not soft.

Victoria (Sealers Cove, Yarra), Tasmania, New Zealand.



Fig. 146.—*Bostrychia Harveyi*: a, plant; b, part of a branch; c, a ramulus; d, transverse section of stem. (After Harvey.)

Subfamily Dasyeae (Kutzing) Schmitz and Falkenberg.

THURETIA Decaisne.

Frond stipitate; stipes filiform, inarticulate, branched; the branches bearing pinnatifid, compressed or flattened, midribbed and penninerved networks, formed of confervoid, anastomosing ramelli. Cystocarps urceolate, springing from the midribs of the network, and containing a tuft of pear-shaped spores. Stichidia subglobose, sessile on the lateral nerves of the network, containing tripartite tetraspores.

Thuretia quercifolia Decaisne.

Network flattened, linear oblong, lobed or subpinnatifid; the lobes broadly oblong, obtuse, fimbriato-dentate; articulations about twice as long as broad. Cystocarps much acuminate. Attachment discoid. Stems many from the same base, filiform, cartilaginous, elongate, often spirally coiled round each other, or so interwoven as to be inextricable, naked below

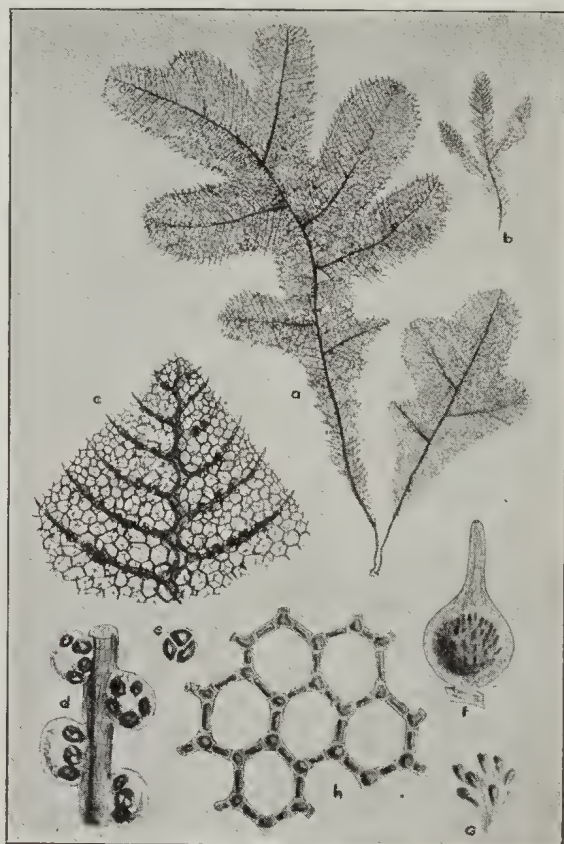


Fig. 147.—*Thuretia quercifolia*: a, summer frond; b, fragment of winter frond, bearing tetraspores; c, apex of an old network, with stichidia on the lateral nerves; d, small portion of a nerve with its stichidia, denuded; e, tetraspore; f, ceramidium; g, spores; h, fragment of the net. (After Harvey.)

and laterally branched; the branches passing into the bases of the network, through which they are continued to the summit as midribs. The frond consists of a double system of growth: an axis or skeleton which forms a framework, and a superficial network. The axis is externally inarticulate, but formed of numerous longitudinal cells surrounding a central cell. It emits distichously at intervals of about $\frac{1}{2}$ mm. lateral polysiphonous ramuli which spread subhorizontally and constitute the nerves of the penninerved frond. Over this closely pinnated framework is spread the net, which is composed of anastomosing confervoid ramelli that issue from the sides of the midrib and nerves; the extremities are free and stand out from the surface like hairs. The general form of the frond resembles that of an oak leaf, between lyrate and pinnatifid; the margin is fringed with teeth-like, multifid fibrils, which disappear in old specimens. In the winter season the stems become partially or wholly denuded, and are then found bearing fruit of both kinds. The cystocarps always spring from the midribs and generally near the summits, one on each lobe; they are shaped something like an amphora with a long projecting neck. The stichidia are formed only on the lateral nerves, likewise towards the apices of the lobes; and what may be called the tetrasporic inflorescence, constitutes an ovate, distichously pinnated, compound spike; each individual stichidium being very minute, roundish, and producing three or four tetrasporangia. The substance though tender is not gelatinous, and does not soon decay in fresh water. Colour rosy or brownish-red; adheres closely to paper.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Kangaroo Island, West Australia.

Thuretia teres Harvey.

Network compressed terete, bi-tripinnatifid; laciniae linear, cylindrical, obtuse, without lateral nerves; articulations twice as long as broad; stichidia ovoid, binate or ternate, springing from the midrib, their prolonged apices passing into the threads of the network.

Attachment or holdfast spongy. Fronds densely tufted, 4 cm. to 10 cm. high, and as much in the expansion of the branches, bi-, tri-, or pluri-pinnatifid, the laciniae, varying from 2 mm. to 6 mm. in diameter, terete or compressed. Each frond consists of a percurrent, continuous axis or main filament, which emits lateral, distichous, opposite or alternate branches, this axis and its branches whorled throughout with closely placed confervoid ramelli, which spread horizontally; these ramelli are formed on a dichotomous type, but their branches anastomose continually into the meshes of a loose, spongy network, which thus imperfectly encloses the axis, and constitutes the visible frond. The apices of the ramelli are free and project from the surface of the spongy branches of the network. The stichidia are developed in the bases of the anastomosing ramelli, constituting the net, a little above the point where these issue from the axis; they are ovoid, or shortly fusiform, two or three growing together, and each contains a few large, irregularly placed tetraspores. Antheridia are formed on free processes of the ramelli

at uncertain points of the network; they are oval, containing minute granules. Colour pale-rose fading to dirty red-brown in drying. Substance membranous, not gelatinous, closely adhering to paper in drying.

Victoria (Port Fairy, Port Phillip, Western Port).

DASYA Agardh.

Frond filiform or compressed, dendroid; stem and branches coated with small, polygonal cells (rarely articulate and many tubed), the axis articulate, composed of numerous radiating cells surrounding a central cavity; ramelli articulated, one-tubed. Cystocarps ovate and urceolate. Stichidia lanceolate, attached to the ramelli and containing triangularly divided tetraspores in transverse rows.

Dasya Wilsonis J. Agardh.

Frond terete, ecorticate; ramuli subdichotomous, above forming loose corymbs, below irregularly pinnate; the ramelli monosiphonous almost from the base, very dense, somewhat spongiöse, widely dichotomous, thick and curved, contracted at the joints; younger ones acuminate, the lower ones obtuse. Stichidia carried at the apices; stichidia short, ovate, sub-lanceolate, pedicellate, monosiphonous, fertile in alternate articulations.

South Coast of Australia.

Dasya hapalathrix Harvey.

Stem very long, over 1 metre, percurrent, inarticulate, quite glabrous; branches lanceolate in outline, alternate, twice or three times pinnately decomposed, the ultimate ramifications setaceous, all corticated and opaque; ramelli confined to the ultimate branchlets, very soft and byssoid, dichotomous, their articulations four to five times as long as broad. Cystocarps sessile, urceolate, with a prominent orifice. Stichidia ovate-lanceolate, acuminate.

Attachment or holdfast discoid. Frond 2 mm. to 4 mm. in diameter, with a linear-lanceolate general outline, not perfectly distichous; with a percurrent, glabrous and glossy, opaque stem, set at intervals of 2 cm. to 5 cm. with lateral branches, the lower and middle ones of which are about 25 cm. long, the upper gradually shorter, all somewhat attenuated at the base and glabrous and inarticulate like the stem. These branches are closely set with subspirally inserted, alternate, slender, secondary branches, which sometimes bear a third and fourth series, sometimes only a third. The latter series rapidly diminish in diameter, as compared with the set from which they spring, and the ultimate divisions are barely setaceous, almost capillary. All, to the smallest, are clothed with cortical cellules, without trace of articulation. Ramelli are only found on the ultimate setaceous branchlets, and only on their upper half; they are densely crowded, excessively slender, and very soft, but tough and not soon decaying in fresh water, 4 mm. to 6 mm. long and repeatedly dichotomous, of a rosy colour. The cystocarps are of small size compared with other species, and sessile

on the setaceous branches. The stichidia are generally solitary on the ramelli and taper from a broad base to a fine point. Colour rosy red. Substance tough. Adheres closely to paper in drying.

South Australia (Eastern Bays), Victoria, Tasmania.

Dasya hirta J. Agardh.

The rachis of the frond is densely corticate below, the upper part of the ramuli four siphoned, all fronds conspicuously hirsute from the base;



Fig. 148.—*Dasya hapalathrix*: a, stem and lateral branch; b, ramulus with conceptacles; c, conceptacle; d, ramulus with stichidia; e, stichidium. (After Harvey.)

ramuli and ramelli very much branched and intertwined, ramelli polysiphonous, alternately patent, and pinnate; the ramuli corticate, patently branched all around, the secondary ramelli nonsiphonous, rigid, acuminate. Antheridia in terminal pencils.

Victoria.

Dasya Hoffiae Harvey.

The frond, the ramuli and ramelli densely subspongiose, long, compressed, irregularly pinnate, corticate to the apices; the rachis between the pinnae, which are distichous, branched and squarrose; ramelli issuing from the

cortex, subverticillate, monosiphonous from the base, branching densely into smaller ramelli, which are dichotomous. Stichidia oval, mucronate. Cystocarps below the apices of the inflated pinnellae, globose, rostrate.

Victoria, Tasmania.

Dasya Cliftoni Harvey.

Stem long, slender, flexuous or spiral, glabrous, inarticulate, subdistichously branched, bi-tripinnate; pinnae patent, glabrous; pinnules alternate, subdistant, ramelliferous; ramelli divaricately much branched, dichotomous, scarcely attenuate, obtuse, their articulations three to four times longer than broad. Stichidia lanceolate.

Attachment or holdfast discoid. Fronds densely tufted and rarely extricable, 25 cm. or more in length, less than 1 mm. thick, gradually attenuated upwards, subdistichously bi-tripinnate. The main stem and primary branches are everywhere inarticulate, being coated externally with a layer of slender, cylindrical, longitudinal, parallel cellules, and are glabrous or bare of ramelli; the penultimate branchlets or pinnules are alone ramelliferous. These are from a quarter to half an inch in length, and densely clothed on all sides with dichotomous ramelli, which are

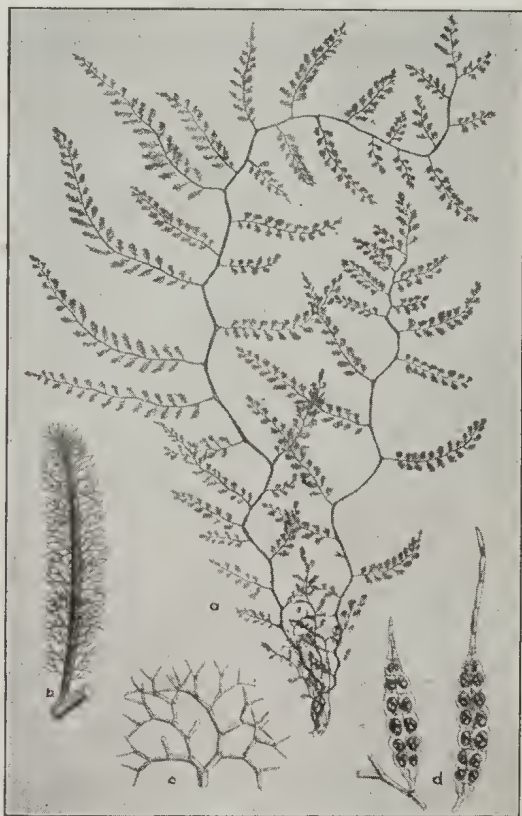


Fig. 149.—*Dasya Cliftoni*: a, plant; b, a pinnule clothed with ramelli; c, a ramellus; d, stichidia. (After Harvey.)

peculiarly crowded at the tips, into a dense dark spot-like fascicle. These ramelli are about a tenth of an inch long, very many times forked, the forkings divaricate; they are not much attenuated upwards, nor are the ultimate divisions drawn out into slender fibres, but end in a short obtuse point. They are single-tubed, the articulations about three or four times as long as broad, but varying in different specimens. The stichidia are lanceolate, acuminate, and sometimes ending in a hair-like point, and are borne on the ramelli; they contain tetrasporangia set in a double row. The colour is full deep blood-red. The substance is soft, but not gelatinous, and adheres firmly to paper in drying.

South Australia (Investigator Strait), West Australia (King George Sound, Fremantle).

Dasya elongata Sonder.

Frond 30 cm. or more long, 2 mm. to 3 mm. thick, cartilaginous, firm, very much, but irregularly, branched; branches alternate, patent, elongate, once or twice alternately divided, the lesser branches simple and virgate, laxly set with very patent setaceous ramuli from a quarter to half an inch in length. All parts of the frond, except the ramuli, are naked; these are naked at the base, but densely clothed in their upper half with minute dichotomo-multifid, divaricating, single-tubed, rigid ramelli. Stichidia very short and broad, acuminate.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia.

Dasya naccarioides Harvey.

Frond 30 cm. to 50 cm. in length, cartilaginous, shrinking in drying, quite bare of ramelli, undivided, set throughout with numerous undivided, elongated lateral branches, which are furnished with a second and third series in a pinnate or bipinnate manner. The ultimate branchlets are setaceous, from 8 mm. to 15 mm. in length, erecto-patent, naked at base but with their upper half densely clothed with very slender and flaccid, single-tubed, jointed ramelli. These ramelli are not $\frac{1}{2}$ mm. long, patent, quadrifarious, many times dichotomous, with patent axils; their lower part thick with short joints, their upper very slender and attenuated with much larger joints. Stichidia born on the ramelli, pedicellate, ovate, acute or mucronate. Colour pale-red.

South Australia (Eastern Bays), West Australia, Tasmania.

Dasya capillaris Hooker fil et Harvey.

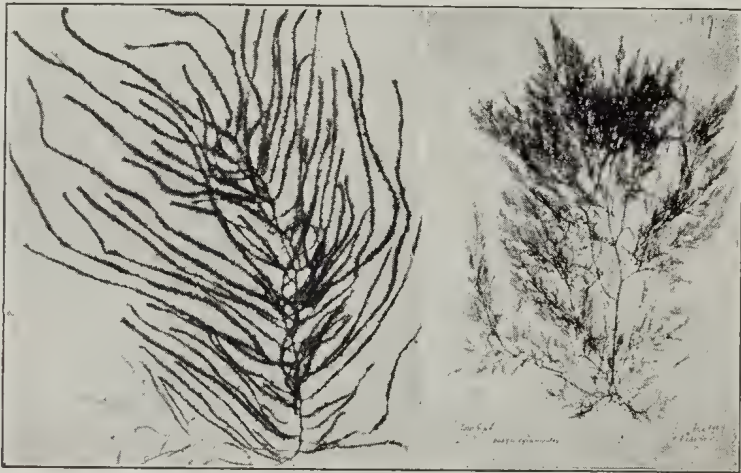
Frond 10 cm. to 20 cm. high, less than 1 mm. thick at the base, attenuated upwards and very fine in the lesser divisions. Stem densely tufted, inextricable; lesser divisions irregularly dichotomous, set with lateral ramuli which terminate in dichotomous, byssoid single-tubed filaments. Stems inarticulate below, but all the branches articulate, of eight tubes, four striate, the joints three to five times longer than broad. Stichidia stalked, lanceolate, tapering into a fine point, frequently terminating in a long byssoid filament. Colour a fine purplish-crimson.

South Australia (Eastern Bays), Tasmania.

Dasya villosa Harvey.

Frond 30 cm. to 60 cm. long, excessively branched and bushy, many times divided, alternately. Branches crowded. All parts of the frond, except the older portions of the stem, are densely clothed with exceedingly slender quadrifarious articulated dichotomous filaments or ramelli. These are either whorled or pencilled, but though crowded are irregularly scattered over the surface; they are 4 mm. to 8 mm. long, repeatedly but distantly dichotomous, with acute axils and joints four or five times longer than broad. The colour is a dark vinous red, becoming brownish in drying. Cystocarps springing from the stem, on thick inarticulate pedicels, urn-shaped, with a slender protruding mouth. Stichidia borne on the ramelli, oblong, more or less acute or mucronate, but not attenuate.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia, Tasmania.

Fig. 150.—*Dasya villosa*.Fig. 151.—*Dasya ceramioides*.*Dasya urceolata* Harvey.

Fronds 4-5 cm. long, in Tasmania up to 15 cm.; terete, widely pinnately branched, wholly corticate, stem and longer ramuli naked below, above subpenicillate, branched; ramelli fasciculate, issuing from the cortex, monosiphonous at the base, below acutely dichotomous, becoming simple elongate, rather attenuated, obtuse, bearing stichidia at the apices. Stichidia pedicellate, sublanceolate. Cystocarps born in the short penicillate branches, ovate, urceolate.

Victoria (Port Fairy), Tasmania.

Dasya ceramioides Harvey.

Frond 20 cm. or more long, about 1 mm. in diameter below, gradually attenuated, several times irregularly pinnated. Branches flexuous, not distinctly jointed, but somewhat constricted at intervals of four or five diameters, triply pinnate; the pinnulae more evidently articulated, the articulation swelling upwards. Ramelli simple, erecto-patent, contracted

at the base, tapering to a very acute point; their joints twice or thrice as long as broad, contracted at the dissepiments. The stichidia are exceedingly minute, and born on long, slender jointed pedicells issuing from the ramelli; they produce tetrasporangia in a triple row. The cystocarps are ovate-urceolate, with a very prominent mouth. Colour a fine crimson. Substance rather flaccid.

Victoria (Sealers' Cove), Tasmania.

Dasya spyridioides Falkenberg.

Frond very much branched, 8 or more cm. long, very strongly corticate, penicillate, regular, the filaments of the pencills furcate, monosiphonous, rigid, only at the base polysiphonous, above changed into stichidia. Stichidia pedicellate, monosiphonous, one to three articulations, bearing tetrasporangia arranged in straight lines.

South coast of Australia.

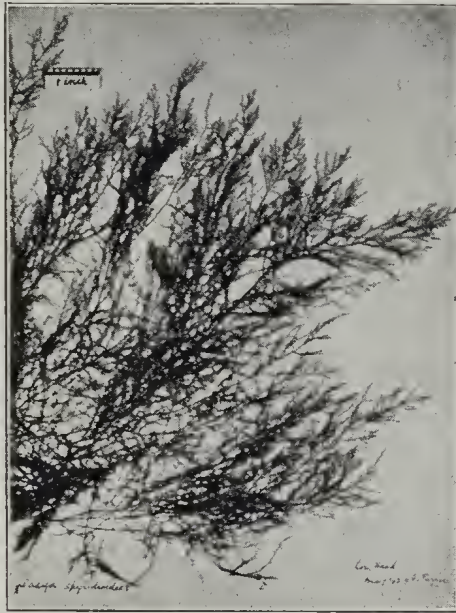


Fig. 152.—*Dasya spyridioides*.

Dasya adunca J. Agardh.

Frond dwarf, terete, creeping, sparsely branched, ramuli articulate, ecorticate, branched and squarrose; ramelli monosiphonous, issuing from the articulations, alternate, subdivaricate, pinnate, elongate, curved; the articulations of the ramuli are four siphoned. Fruit unknown.

West Australia (King George Sound).

Dasya atactica J. Agardh.

Frond minute, 4 cm. to 7 cm. long, arboriform, the ramuli on the upper part of the stem dichotomous, subpinnate, subcorymbose, hirsute, thinly corticate above, articulate, polysiphonous; the ramelli polysiphonous below,

more or less separated, interspersed above with smaller, monosiphonous ramelli, at the base thicker, soft, attenuated. Stichidia suberistate at the apices, and on the sides of the hairy penicillate ramelli.

South coast of Australia.

Dasya velutina J. Agardh.

Frond 6 cm. to 10 cm. long, or more, about $\frac{1}{2}$ mm. thick, cartilaginous, scarcely attenuated, alternately branched, the branches simple, or furnished with a second or third series of lesser branches. The older parts of the frond naked, but all the young branches densely covered with minute equal ramelli, resembling a pile of velvet. These are less than 1 mm. in length, very patent, many times dichotomous, with very patent forkings, their apices acute. Colour full red.

South Australia (Eastern Bays).

HETEROSIPHONIA Montagne.

Fronds mostly erect, of dorsiventral construction, caulis usually complanate, structure cellular or filamentous-cellular. Branching primarily sympodial, crescentic, apices erect or incurved, each articulus two, rarely three to eight biseriate, proliferous from margin of secondary branches. Pericentral cells four to six or more, soon externally corticated. Cystocarps ovoid or urceolate, lateral on the branches, sessile or pedicellate. Antheridia occupying a similar position to the tetrasporangia, mostly elongate, on polysiphonous pedicels. Stichidia on young ramuli, construction almost radial, elongate, terete, borne on polysiphonous pedicels (rarely monosiphonous), tetrasporangia four to six verticillate.

Heterosiphonia microcladioides (J. Ag.) Falkenberg.

= *Dasya pellucida* Harvey.

Frond tufted, about 3 cm. high, but slightly branched; the branches alternate, undivided and very erect, closely beset with short multifid dichotomous branchlets. Articulations visible in all parts of the frond, very short. Colour carmine.

West Australia (King George Sound), Victoria (Port Phillip).

Heterosiphonia callithamnion (Sond.) Falkenberg.

= *Polysiphonia callithamnion* Sonder.

A minute plant, 5 mm. to 15 mm. in length, with a subsimple (possibly becoming branched) pellucidly jointed stem, densely clothed with very patent, quadrifarious, imbricated, dichotomous ramuli. Tubes four, large, surrounding a rather wide central cavity.

West Australia.

Heterosiphonia Gunniana (Harv.) Falkenberg.

= *Dasya Gunniana* Harvey = *Dasya lawrenciana* Harvey.

Frond 30 cm. or more long, from 1 mm. to 2 mm. in diameter below, attenuated upwards, flexuous, repeatedly and at length excessively branched, opaque and inarticulate below, more or less distinctly jointed above. Branches alternate, patent, long, flexuous, the larger ones bipinnate,

the smaller simply pinnate. Pinnae and pinnulae with a fan-like outline regularly circumscribed, many times dichotomous, the divisions gradually tapering to fine points; many tubed in their lower part, becoming less and less compound towards their apices, and ending in single-tubed, dichotomous filaments. Substance tender, closely adhering to paper. Colour brilliant red. Cystocarps very large, at first ovate, afterwards nearly globose, seated below the terminal filaments. Stichidia lanceolate acuminate, stalked, borne near the apices of the polysiphonous part of the frond.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia, Victoria, Tasmania.

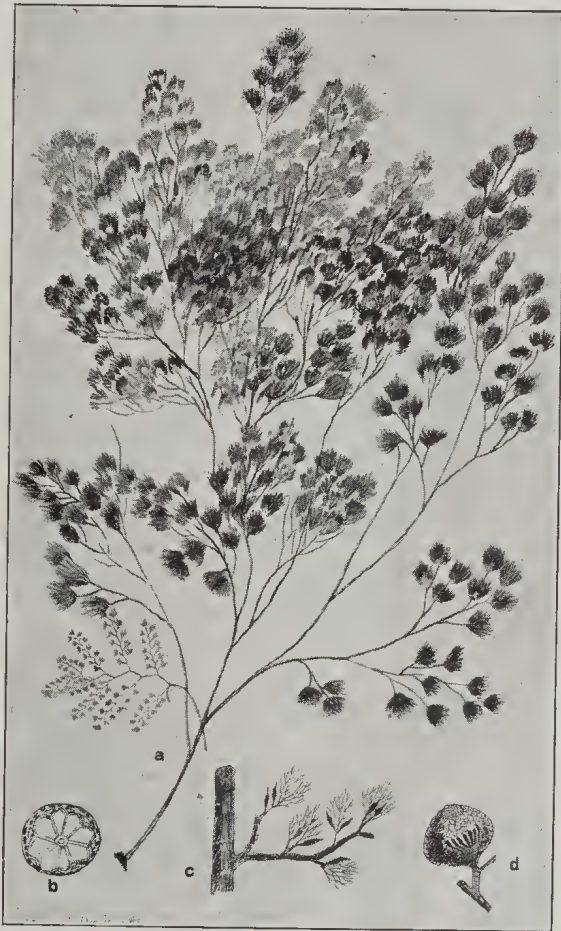


Fig. 153.—*Heterosiphonia Gunniana*: a, portion of a frond; b, cross-section of stem; c, part of branch, with small pinna and stichidia; d, cystocarp. (b to d, after Harvey.)

Heterosiphonia wrangelioides (Harv.) Falkenberg.

= *Dasya wrangelioides* Harvey.

Stems numerous, rising from decumbent, creeping filaments, 4 cm. to 10 cm. long, setaceous, furnished with a few, irregularly alternate or secund, simple, patent, incurved branches; all parts of the stem and

branches pellucidly articulated. Stem and branches set throughout, at distances of 1 mm. or less, with distichous, very minute, ramelliferous ramuli. Ramuli less than 2 mm. long, clothed with multifid, squarrose, monosiphonous ramelli of about their own length. Cystocarps borne on the ramuli, globose, with a long, protruding, cylindrical neck and erenulate aperture, arcolated, containing a dense tuft of strings of oblong or oval spores. Stichidia very minute, on the ramelli, varying from ovate-aeute to oblong-lanceolate, seldom containing more than two to four tetraspores. Colour a deep crimson-red. Substance membranous, adhering weakly to paper.

Western Australia, Victoria, South Australia (Investigator Strait).

Heterosiphonia multiceps (Harv.) Falkenberg.

= *Dasya multiceps* Harvey.

Frond 4 cm. to 8 cm. long, caespitose from a coarse attachment, simple or sparsely pinnate, articulate; pinnellae secund, distichous, dichotomously pinnate, polysiphonous at the base, becoming monosiphonous in the ramelli, which are elongate, attenuate, and subfasciculate, bearing stichidia at the apices. Stichidia scattered among the pinnellae, carried on polysiphonous stems, lanceolate linear, the articulations of the pinnae 8-11 siphoned.

West Australia (Rottnest Island, Fremantle).

Heterosiphonia? guichensis (Reinb.) De Toni.

= *Dasya guichensis* Reinhold.

Frond 8 cm. long, slightly compressed, wholly articulate, subspongiose below, widely branched, with pinnae and pinnellae; stem and ramuli, articulate, 10 siphoned; pinnae and pinnellae issue from the articulations, secund, alternate and distichous; pinnellae below polysiphonous, becoming monosiphonous, divaricate, dichotomous. Stichidia formed on the polysiphonous ramelli, with a polysiphonous pedicel; the young ovate, fully developed sublanceolate, almost cylindrical, with two rows of tetrasporangia.

South Australia (Eastern Bays).

Heterosiphonia crassipes (Harv.) Falkenberg.

= *Dasya crassipes* Harvey.

Frond 7-10 cm. long, thickly eorticate, terete, pinnate, irregularly branched; the ramuli eorticate, very densely branched, spongiose, issuing distichously, densely fasciculate, with monosiphonous pinnae, bearing stichidia. Stichidia lanceolate, carried very thickly near the stem. 8-12 siphons in the ramuli. Cystocarps large, inflated, globose, pedicellate. Colour red, drying darker; substance rigid, adhering more or less to paper.

West Australia (Rottnest Island).

Heterosiphonia Curdieana (Harv.) Falkenberg.

= *Dasya Curdieana* Harvey.

Frond up to 25 cm. long, above eorticate for a long distance, terete, pinnate, irregularly branched; the ramuli below are eorticate; the young ramuli articulate, bare at the base, and branched above; ramelli pinnately

branched or dichotomous; the pinnae are monosiphonous, subulate. Stichidia ovate, pedicellate. Twelve siphoned.

South Australia (Investigator Strait, Eastern Bays).

Heterosiphonia Muelleri (Sond.) De Toni.

= *Dasya Muelleri* Sonder.

Stem elongate, 30 cm. or more in length, robust, densely hairy, subdichotomous; secondary branches very long (20 cm. to 40 cm.), much more slender than the stem, glabrous, corticated, simple, often naked below, plumose-pinnated above; pinnae alternate, close, horizontal, subarticulate, pinnulate; pinnules very short, few-tubed, ramelliferous; ramelli dichotomous, attenuated, obtuse, their articulations two to four times longer than broad; cystocarps large, pedicellate, inflated, with a prominent orifice; stichidia minute, linear-oblong, acute at each end.

Attachment or holdfast, a thick, villous mass. Primary frond perennial, to 20 cm. or more in length, 2 mm. to 4 mm. in diameter, shaggy, with dark-red woolly hairs, irregularly divided, or dichotomous, its branches widely



Fig. 154.—*Heterosiphonia Muelleri*: a, plant; b, portion of pinnule, bearing a ceramidium; c, branch from the decomposed (dendroid) placenta, bearing spores; d, a pair of stichidia; e, portion of ramellus. (After Harvey.)

spreading. This primary frond emits an annual crop of deciduous, slender, glabrous branches, 20 em. to 50 em. long, and either simple or emitting laterally from a main branch or rachis, several similar, long, simple branches. The branches of either series are generally denuded at the base, and closely pinnated above with horizontal pinnae, which are from 1 em. to 3 em. long, and older ones becoming pinnulate. Both pinnae and pinnulae are clothed with very slender, dichotomous, rose-red, soft ramuli. The cystocarps ovate, much inflated, with a prominent orifice; the spore-filament is excessively branched, resembling a miniature tree, loaded with innumerable pear-shaped spores, and nearly fills up the cavity of the pericarp. The stichidia are of small size and clustered. The colour, when quite fresh, is a beautiful clear rosy-red or crimson, but old specimens are frequently brownish-red. The substance of the primary stem is rigid, that of the branches very soft and flaccid. The plant adheres closely to paper.

South Australia (Holdfast Bay, Eastern Bays), West Australia, Tasmania.

Heterosiphonia struthiopenna (J. Ag.) De Toni.

= *Dasya plumigera* Harvey.

Frond 7-12 em. long, stem for 2 em. to 5 em. lightly hirsute and coarse, compressed; ramuli irregularly pinnate, at the apices almost areolate, eortieate, the lower pinnae of the ramuli are in tangled masses, the middle ones longer, branched and squarrose; ramelli secund, substichous, with very dense dichotomous pinnae, which are divaricate, entangled, monosiphonous. Six to seven central siphons. Cystocarps large, on the short ends of the polysiphonous ramelli. Bright red; adheres to paper. (Very similar to *H. Muelleri*.)

West Australia (King George Sound).

HAPLODASYA Falkenberg.

Frond parasitic, erect, terete, dorsiventral; stem clavate, sympodial; the secondary ramuli developed spirally on the sympodial axis; four central cells; the rhizoids are eortieate. Cystocarps large, arranged spirally on the principal sympodial axis. Stichidia developed at the apices of the young ramuli, in the short lateral sympodia, numerous, dorsiventral, pedicellate, subareolate. Tetrasporangia in a longitudinal row on the convex side. Antheridia arranged as tetrasporangia.

Haplodasya Reinboldii Falkenberg.

Frond dwarf, less than 3-4 mm. high. The only species, with the characters of the genus.

South Australia.

HALODICTYON Zanardini.

Frond a tubular (simple or forked) network, formed by numerous inosculating, confervoid filaments; the meshes irregular, emitting at the angles free, horizontal ramelli. Cystocarps urceolate, containing a tuft of pyriform carpospores. Stichidia lanceolate, containing a single or double row of tetraspores.

Halodictyon australe Harvey.

= *Hanowia australis* Sonder.

Network cylindrical, repeatedly forked, bristling with excurrent, free ramuli; filaments capillary, the primary articulations cylindrical, about four times as long as broad; cystocarps pedicellate, ovate-urceolate, with a prominent orifice.

Fronds originating in a sponge-like amorphous network of anastomosing filaments; several from the same base, cylindrical, 4 cm. to 8 cm. long, 4 mm. to 6 mm. in diameter, subsimple, or once, twice, or thrice

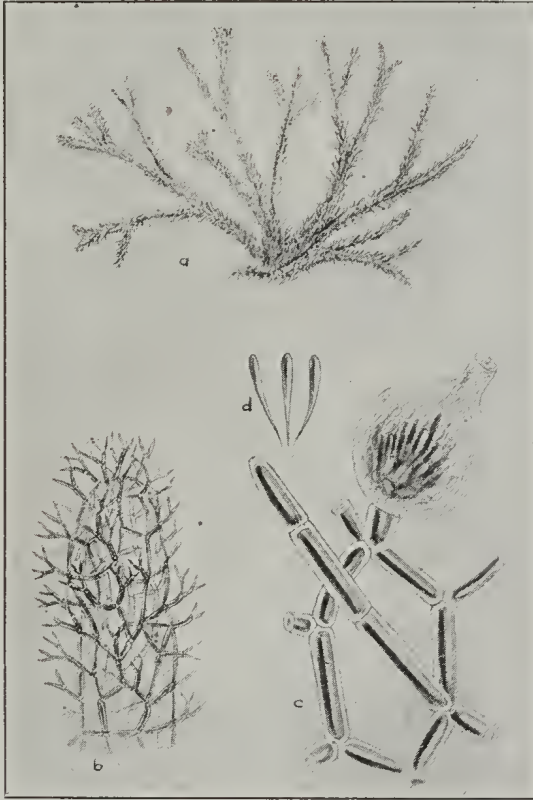


Fig. 155.—*Halodictyon australe*: a, plant; b, portion of a branch of the network; c, a mesh, a ramulus, and a ceramidium; d, spores. (After Harvey.)

forked. The cylindrical frond is formed of several parallel longitudinal, branching filaments, whose branchlets anastomose into the polygonal meshes of the tubular network, forming five or six-sided meshes. From the angles of these meshes are given off externally short, spreading or horizontal, free, once or twice forked ramelli, which spread in all directions and give the frond, to the naked eyes, a shaggy aspect. The whole frond is pellucidly articulated and composed of monosiphonous filaments; the articulations of the meshes are three to four times as long as broad, those of the ramuli about the same or shorter. The cystocarps are born on the free ramuli, the fertile ramulus being shortened to a single joint; they are somewhat

inflated, with a projecting orifice; the spores are very narrow-pyriform, or rather clavate. The colour is a clear red, discharged in fresh water; in drying it becomes darker and browner. The substance is membranous and juicy, rather quickly decomposing; and in drying the plant adheres strongly to paper.

West Australia (Fremantle).

Halodictyon robustum Harvey.

= *Hanowia robusta* Harvey.

Network compressed; filaments setaceous, the primary articulations ovoid, much contracted at the joints, two-three times longer than broad; stichidia ovate-oblong, with beaded margins; tetrasporangia biserial. The network forms an irregular sponge-like mass, bristling with small hair-like ramuli and showing indications of erect branches, which probably (in full-grown specimens) become repeatedly forked. The filaments composed of oblong oval cells, containing deep-red endochrome, surrounded by a wide hyaline limbus. The articulations vary in length, but are rarely more than thrice their diameter. The stichidia are often in pairs and issue from the angles of the network or from a free ramulus; they are bordered with a row of inflated, pellucid cells that look like beads and contain dark-red tetraspores in a double row.

South Australia (Eastern Bays), West Australia (Fremantle), Victoria (Western Port).

Halodictyon arachnoideum Harvey.

= *Hanowia arachnoidea* Harvey.

Network compressed, repeatedly forked; filaments arachnoid, the primary articulations cylindrical, six to eight times as long as broad. Network 2 cm. to 10 cm. long, at first decumbent, spreading vaguely over other algae or old shells; afterwards throwing up erect or ascending branches, which are at first simple, then forked, and finally repeatedly dichotomous. All the axils are remarkably obtuse and the arms of the forks very patent. The filaments of which the net is composed are excessively slender; the meshes are of unequal size, pentagonal or hexagonal, and emit from the angles short, horizontally patent ramuli. These latter usually consist of a single cell. The articulations are all cylindrical, not contracted at the points, and are filled with rose coloured endochrome. Substance is delicately membranous, and the frond closely adheres to paper in drying.

South Australia (Holdfast Bay, Kangaroo Island), West Australia, Tasmania.

Halodictyon velatum Reinbold.

Frond simple (?); filaments loosely netted, anastomosing, the peripheric filaments free, long, many times dichotomous, attenuated above. Stichidia developed on the peripheric filaments chiefly singly, with a long and short pedicel or sessile, ovate, acuminate, carrying a double row of tetrasporangia.

South Australia (Eastern Bays).

TYLOCOLAX Schmitz.

Frond parasitic, rising from within the thick cellules of the parent stem, forming a sub-lobate swelling or cushion; five central cells; the rhizoids corticate; monopodial growth; the fruit is found in the swelling or cushion. Stichidia linear, elongate, immature ones are subarcuate. Tetrasporangia in two rows in the stichidia. Antheridia ovoid. Cystocarps ovoid, shortly pedicellate, pericarp thin.

Tylocolax mictocarpus Schmitz.

The only species with the characters of the genus. Growing on *Lenormandia spectabilis*.

Southern Australia.

Family CERAMIACEAE (Bonnemaison) Naegeli.

CONSPECTUS OF THE SUBFAMILIES.

I.—Fronds extremely confervoid, young fronds always uniseriate, articulate.

Spermothamnieae. Fronds filiform, usually naked, laterally branched. Cystocarps terminal, often involucreted with ramuli, gonimoblasts one to two composite. Sporangia triangularly divided, sometimes polysporous (spores 60 or more).

Griffithsieae. Fronds naked or clothed with short verticillate ramuli. Cystocarps on ramuli proper, terminal, involucreted. Gonimoblasts (nucleus) composed of one to two gonimolobes. Tetrasporangia triangularly divided.

Monosporeae. Fronds filiform, naked. Cystocarps on fertile ramuli, terminal, formed from a single gonimoblast, involucreted in various ways. Sporangia triangularly or radially divided into many parts.

Callithamnieae. Fronds filiform, naked or corticated with downwardly directed rhizoids. Cystocarps lateral (sometimes apparently terminal), not involucreted, gonimoblasts double (rarely single). Tetraspores cruciately or triangularly divided.

Spongoclonieae. Fronds naked when young, long, becoming corticated with lateral ramuli of spongy-intricate texture. Cystocarps on short terminal ramuli (apparently laterally fixed), involucreted. Gonimoblasts evolving from successively formed round gonimolobes. Tetrasporangia triangularly divided.

II.—Branches naked or with short ramelli, or corticated with rhizoids or with a true continuous cortex. Cystocarps usually involucreted with numerous ramelli.

Ptiloteae. Fronds filiform and terete, or plane and two-edged. Cystocarps on fertile terminal pinnae, or apparently lateral. Tetraspores triangularly divided.

III.—Fronds terete or plane and two-edged, central axis articulate and corticated with rhizoids, and with verticillate ramelli. Cystocarps variously placed on the ramelli.

Dasyphileae. Gonimoblasts evolved successively from many round gonimolobes. Tetrasporangia triangularly divided.

IV.—Fronds terete or complanate, or confervoid, with branches covered with abundant short ramuli, or with a central articulate axis and corticated with much branched laterally confluent filaments.

Crouanieae. Gonimoblasts evolved successively from many gonimolobes. Tetrasporangia triangularly or cruciately divided.

V.—Fronds terete or complanate, with a central axis totally or partly corticated with cells, mostly internally, some externally. Cystocarps involucrate, ramelli not concomitant.

Spyridieae. Fronds terete, branching in all directions, with a central axis of large cells. Cortex continuous or locally interrupted. Cystocarps on short ramuli, terminal, primarily bilobed, eventually irregularly three to many lobed. Tetrasporangia triangularly divided.

Ceramieae. Frond terete or compressed, sometimes (when parasitic) pulvinate, furcately branching, apices often involute, central axis of large cells. Cortex continuous or confined to the nodes. Cystocarps lateral or terminal, with involucrate ramelli. Tetrasporangia triangularly (and also cruciately?) divided.

Subfamily Spermothamnieae Schmitz.

LEJOLISIA Bornet.

Frond filiform, articulate, monosiphonous, glabrous, filaments radiating, irregularly branched; vertical filaments sparsely branched, emitting short fertile ramuli, often opposite at the base. Cystocarps carried in the lateral terminal ramuli, formed from changed apical cells, gelatinous, attached firmly to the articulations of the ramuli. Antheridia oblong, conical, covered with a thin external skin. Tetrasporangia in the terminals of the short lateral ramuli, formed from changed apical cells; obovate, glabrous, triangularly divided.

Lejolisia aegagropila J. Agardh.

Frond globose, caespitose; filaments radiating from the base, simple below, fastigiate, branched above. The ramuli erect and patent, arcuate, here and there subsecund; the ramuli bearing tetrasporangia are unicellular, opposite or subsecund, very short, arcuate, erect, carrying tetraspores at the apices.

South Coast of Australia.

Subfamily Griffithsiae Schmitz.

GRIFFITHSIA Agardh.

Frond filiform, dichotomous, articulated, monosiphonous, naked. Favellae involucrate, containing numerous angular spores. Tetrasporangia attached to the inner faces of involueral ramelli, globose, triangularly parted.

Griffithsia ovalis Harvey.

Attachment or holdfast discoid. Fronds solitary, scattered, 2 cm. to 5 cm. high, flabelliform, subfastigiate, dichotomously or subtrichotomously branched, the branches erecto-patent, the upper ones fairly regularly dichotomous. Articulations three to four times as long as broad, the larger ones 3 mm. in diameter, inflated, very much constricted at the nodes; the lower ones club-shaped or pyriform, the middle ovate or oblong, the upper more exactly oval, the terminal at first globose, then oval. Involucres whorled round the upper nodes, not on separate ramuli; involueral ramelli very minute, of few cells, bearing large tetraspores at their tips. Tetrasporangia globose, with wide borders. Colour pale-red, fading to horn colour. The

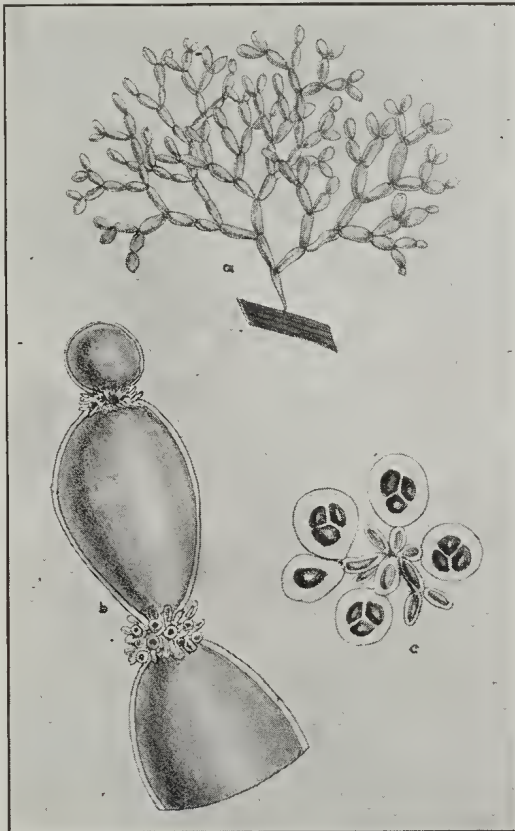


Fig. 156.—*Griffithsia ovalis*: a, plant; b, apex of a fertile branch, with two involucre, in situ; c, ramelli and tetraspores from an involucre. (After Harvey.)

membrane (or cell-wall) of the articulations is very thin, and not so gelatinous as in most *Griffithsia*. Substance soft, adheres to paper.

West Australia (King George Sound).

Griffithsia monilis Harvey.

Frond caespitose, regularly dichotomous, fastigiate, segments erect articulate above, ramelli simple, short, incurved, consistently bearing tetrasporangia. Cystocarps lateral on the articulations.

South Australia (Investigator Strait, Sturt Bay). West Australia, Tasmania.

Griffithsia gunniana J. Agardh.

Frond caespitose, erect, dichotomous; branches alternate, short, intermediate flexuose and overhanging, sublateral fasciculate; branches patent, obtuse, acuminate, articulations sub-contracted at the

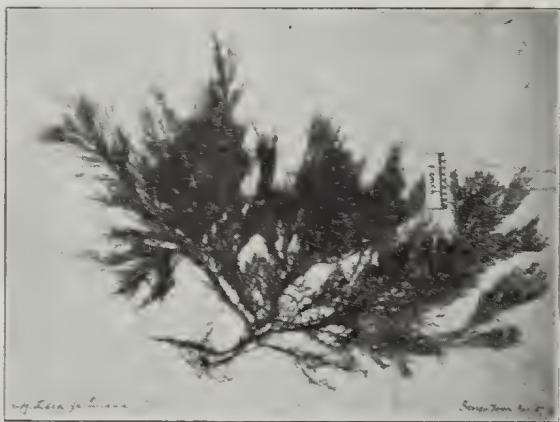


Fig. 157.—*Griffithsia Gunniana*.

nodes, oblong-cylindrical, length four times the diameter. Upper branches at length fruiting, pyriform, with a whorl of tetrasporangia surrounded by short, sterile, verticillate ramuli, in an involucre of simple, abbreviated, incurved ramelli.

South Australia (Eastern Bays), Tasmania.

Griffithsia flabelliformis Harvey.

Frond to 15 cm. long and 18 cm. wide, many times dichotomous, the lower axils very patent, the upper equally acute and close. Joints in the patent portion of the frond cylindrical, four to five times longer than broad; in the erect or upper portion strongly contracted at the nodes, swollen in their middle, and thrice as long as broad; those of the ultimate divisions, which taper to a very fine point, resolved into a string of elliptical beads. Tetrasporangia in ramuli, 3 mm. to 4 mm. long. Colour a fine blood-red. Substance lubricous, not very gelatinous.

South Australia (Eastern Bays), Tasmania, New Zealand.

Subfamily Monosporae Schmitz.

BORNETIA Thuret.

Frond erect, filiform, dichotomous or laterally branched, articulate, monosiphonous, naked. The short lateral branches are fertile. Cystocarps at the apices of the ramuli. Carpospores pyriform, radiating everywhere from the placental cells, placed singly on regular hyaline saccules. Tetrasporangia arranged on the inner side of the involucre at the articulations, fasciculate; young ones pyriform, fully developed ones almost spherical, pedicellate, triangularly divided. Antheridia small, arranged at the involucre in same way as tetraspores.

J. Agardh regards the nature and structure of the frond as very close to *Griffithsia*.

Bornetia Binderiana (Sond.) Zanardini.

= *Griffithsia Binderiana* Sonder.

Frond 2 cm. to 5 cm. long, erect, dichotomous; all ramuli subsecund, subflabellate, widely patent above the axils; the lower ramuli articulate and cylindrical, upper ones obconical, divided at the articulations, the shorter

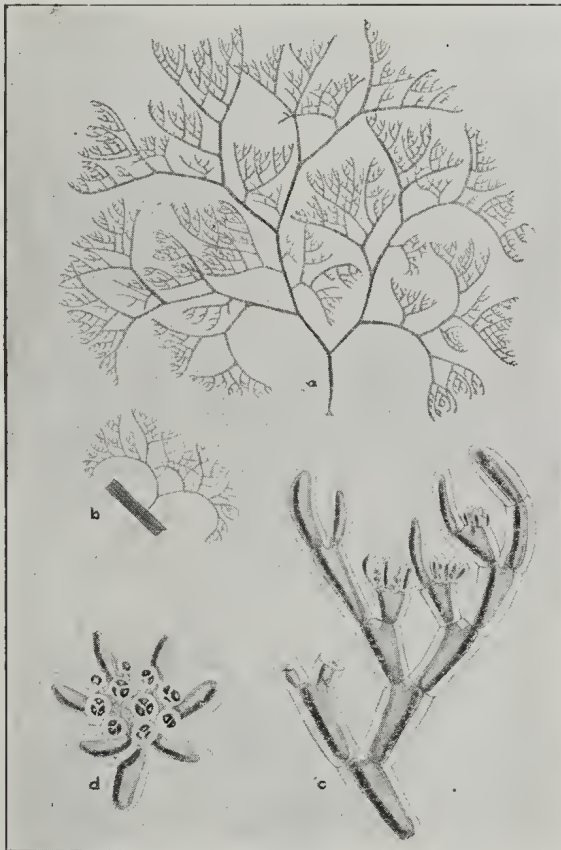


Fig. 158.—*Bornetia Binderiana*: a and b, plants; c, portion of a branch, with involucre, in situ; d, an involucre, removed, and forced open to show the enclosed tetraspores. (After Harvey.)

ones fertile, with an incurved involucre on the furcate ramelli, bearing tetrasporangia arranged on the inner side at the lower articulation, fasciculate. Adheres to paper.

West Australia (Rottnest and Garden Islands), Victoria.

Bornetia Meredithiana J. Agardh.

Fronds erect, dichotomous, branches alternately abbreviated and hanging down on the sides in elongate rachides, extremely pinnate; lower at length apparently opposite at the nodes of the principal rachides, and ramuli decurrent, conjoined at the nodes, laxly stupose; branches and ramuli thick, scarcely diverging; articulations five to six times as long as broad.

South Australia (Eastern Bays), Tasmania.

MONOSPORA Solier.

Fronds erect, filiform, dichotomously or pinnately branching, articulate, monosiphonous, sympodial, below sometimes corticated with rhizoids. Cystocarps on short ramuli, terminal, surrounded by a corona of involucre unicellular ramuli. Gonimoblasts evolved successively from a single or numerous rotund gonimolobes. Tetrasporangia on lateral, slender, densely decomposite branches, aggregated or single in the axils, sessile or shortly pedicellate, round, triangularly divided; in some species nearly always undivided, gemma-like. Antheridia ovoid, similarly situated to the tetrasporangia.

Monospora australis (Harv.) J. Agardh.

= *Corynospora australis* Harvey.

Frond setaceous, gelatinoso-membranaceous, dichotomous-decompound and alternately ramuliferous; branchlets several times forked, the lesser ones very slender; apices much attenuated; articulations of the branches very long, not contracted at the nodes; tetrasporangia oblong, subsessile.

Attachment a small disc. Fronds tufted, 4 cm. to 7 cm. high, less than $\frac{1}{4}$ mm. thick at the base, much attenuated upwards, soon becoming capillary, and thence attenuated to an excessive fineness, repeatedly dichotomous, the upper branches beset with short lateral branchlets. Branchlets 4 mm. to 8 mm. long, very slender, several times regularly forked, the apices much drawn out and slender, subacute. Tetrasporangia formed in the axils of most of the upper forks, oblong, scarcely pedicellate or subsessile, with an undivided dark-red nucleus. Articulations of the larger branches many times longer than broad, with a narrow endochrome, cylindrical, not contracted at the nodes; those of the upper branches and ramuli similar, but much shorter. Colour rosy, becoming darker in drying. Substance very soft and gelatinous, soon decomposing. Adheres to paper.

West Australia (Rottnest Island, Fremantle), Victoria (Port Phillip).

Monospora gracilis (Harv.) J. Agardh.= *Corynospora gracilis* Harvey.

Frond 2 to 5 cm. long, very small, caespitose, fastigate, cauliform; ramelli radiating, branching in all directions from the much thicker stem, pinnate, elongate, soft, attenuated above, many of them furcate; the terminal ones are many times increased, shorter and corymbose.

West Australia (Garden Island), Victoria (Snowy River mouth).

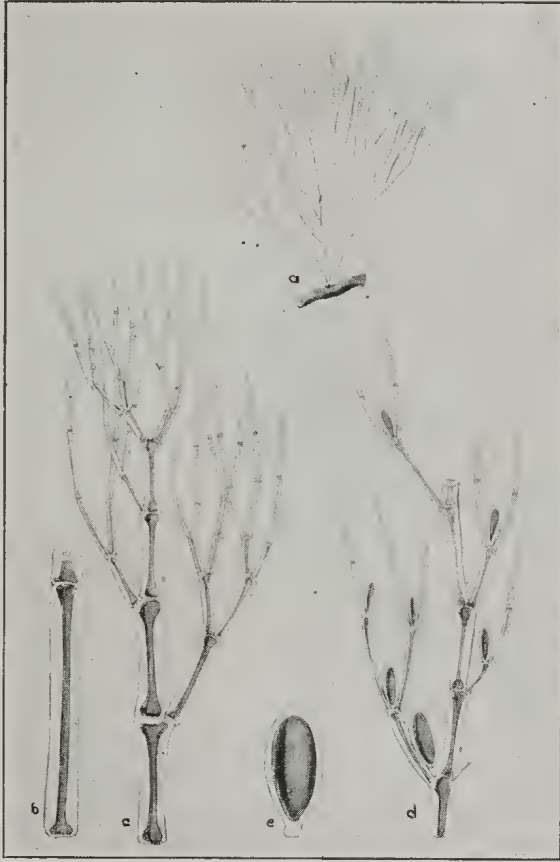


Fig. 159.—*Monospora australis*: a, plant; b, one of the articulations of a large branch; c, apex of a branch, with lateral, forked, attenuated ramuli; d, fertile ramulus, with tetraspores; e, a tetraspore. (After Harvey.)

Monospora (?) *licmophora* (Harv.) De Toni.= *Callithamnion licmophorum* Harvey.

Frond flabelliform, subdichotomously decompound, its stem and principal branches at length coated externally with decurrent, interwoven, and anastomosing fibres; branches spreading to all sides, virgate, set throughout with alternate, flabellate ramuli; ramuli dichotomous, fastigate, their articulations four to five times as long as broad, swollen upwards, their apices subacute; tetraspores pedicellate, solitary in the axils of the ramuli.

Attachment or holdfast a mat of fibres, surrounding a central disc. Fronds loosely tufted, 8 cm. to 15 cm. high, and as much in the expansion of the branches, irregularly divided from the base in a subdichotomous manner, but with the branches and their divisions spreading in all directions. In the young plant the whole frond is pellucidly articulate; nor do the joints of the stem or branches ever become opaque or corticated with internally developed cellules. But they soon are coated externally with decurrent fibres, originating at the insertion of the ramuli and extending downwards, clasping round the branch or stem, and at length enveloping

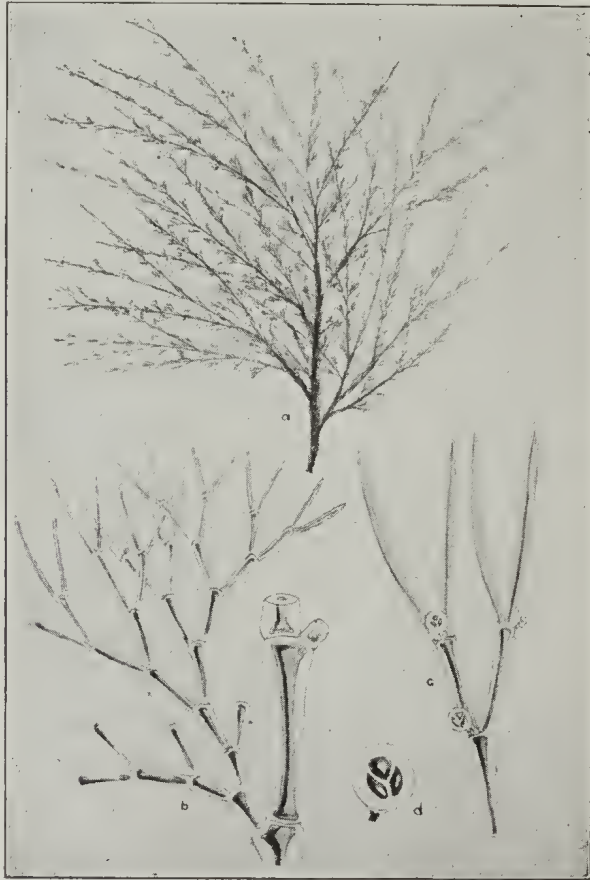


Fig. 160.—*Monospora licmophora*: a, plant; b, a dichotomous branchlet, and a single joint of a branch; c, tip of a branchlet, with axillary tetraspores; d, a tetraspore. (After Harvey.)

it in a filamentous sheath. The shaggy-coated rope-like stem is then often 2 mm. or more in diameter, the major branches about 1 mm., and the lesser ones proportionately less thick, as the coat of fibrils is less developed. The ultimate branches generally remain nude; they are remarkably straight and rod-like, about 5 cm. long, and bear at every node, in alternate but laxly spiral order, short flabelliform ramuli. The ramuli are 2 cm. to 4 cm. long, several times forked, their segments of equal length. The articulations of the branches are five to eight, of the ramuli four to five times as

long as broad; the cell walls are thick and gelatinous and the endochrome narrow. Tetrasporangia are borne in the forks of the ramuli on very short pedicels. The colour is a clear pinky-red; substance soft; and the plant quickly decomposes in the air or in fresh water. Adheres strongly to paper.

West Australia (Garden Island), Victoria (Port Phillip, Western Port).

Monospora (?) *Griffithsioides* (Sond.) De Toni.

= *Griffithsia setacea* Harvey.

Frond 6-10 cm. long or more, erect, fasciculate, fastigiate, irregularly dichotomous; lower apices of the short lateral ramuli are fertile, articulate, cylindrical. Tetrasporangia on the inner side, shortly pedicellate, single at first, then in groups, semi-verticillate. Conspicuously hyaline-limbate. Adheres to paper, which it tints red.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Victoria, Tasmania, New Zealand.

Monospora elongata (Harv.) De Toni.

= *Callithamnion elongatum* Harvey.

Frond caespitose, elongate, wholly articulate, below twisted and sub-funiliform, irregularly dichotomous; ramuli laterally and terminally fasciculate, fascicles fertile, articulate, cylindrical. Tetrasporangia on the lower side of the converging ramelli, shortly pedicellate, single at first, then collected in groups. Cystocarps in the short lateral ramuli.

South Australia (Encounter Bay, Eastern Bays), Tasmania.

PLEONOSPORIUM Naegeli.

Frond erect, finely filiform, alternately distichous or furcately branched, corticate immediately above the rhizoids. Cystocarps grouped laterally at the apices of the ramelli. Antheridia ovoid, arranged in same way as tetrasporangia. Tetrasporangia are polysporous, spores radiating laterally, borne singly on the articulations, on the upper ramuli of the frond.

Pleonosporium (?) *comatum* (J. Ag.) De Toni.

= *Lophothamnion comatum* J. Agardh.

Frond 6-10 cm. long, subconical, ramuli subpaniculate, more or less dense, irregular; the lower ramelli are stupose almost to the apices, the apices very densely branched, ramelli spreading in all directions, elongate, free. Tetrasporangia subsecund in a long row on the interior side of the ramelli.

South Coast of Australia, Tasmania.

Subfamily Callithamnieae (Kützing) Schmitz.

CALLITHAMNION Lyngbye.

Fronds erect, filiform, abundantly furcately or laterally (spreading to all sides or above distichous) branched, monopodial or sympodial, articulate, monosiphonous, naked or at length thickened internally or coated externally with decurrent filaments. Cells plurinucleate. Cystocarps usually twin in the axils or sessile on the ramuli, slightly stipitate, destitute

of a proper involucre, forming many angular hyaline carpospores within the pericarp. Gonimoblasts double (rarely single) evolving successively from gonimolobes. Tetrasporangia sessile or pedicellate on the ramuli, singly or many on each articulus, oblong-spherical, triangularly divided, rarely transversely bipartite. Antheridia numerous, minute, similarly situated to the tetrasporangia.

Callithamnion multifidum Harvey.

Fronds 2 cm. to 3 cm. high, erect, densely caespitose, alternately decompositely branching, ecorticate to the base; branches and ramuli spreading to all sides, terminal corymbose, the corymbose upper and young branches erect and fastigate, the lower and older branches rigid, patent, subdivaricate, attenuate-obtuse. Tetrasporangia single in the axils, sparse, triangularly divided. Articuli of branches at base thick, length four times diameter: the ramuli cylindrical, length two-four times diameter.

South Australia (Eastern Bays), Western Australia (Rottnest Island).

Callithamnion laricinum Harvey.

Attachment a small disc. Fronds subsolitary, setaceous, or. ultra-setaceous, from 5 cm. to 20 cm. high, with an undivided leading stem closely set with lateral, alternate, virgate branches, which are either simple or pinnate; the general frond is therefore either simply or doubly, sometimes triply, pinnate. Both the stem and all the larger and lesser branches are coated with cellules throughout, no articulation being externally visible except near the extremities and on the very young branches; the surface of the larger branches is smooth. All the young and smaller branches are closely set with minute, alternate, many times dichotomous, fastigate, pellucidly articulate ramuli, which are 1 mm. to 2 mm. in length. Articulations of the ramuli five to three times as long as broad; apices spreading obtuse. Favellae on the ramuli, generally consisting of two divergent lobes, ovate-oblong or acuminate. Tetrasporangia globose, lateral or axillary on the forks of the ramuli, sessile. Colour a deep brownish-purple, becoming darker in drying. Substance very soft in young plant: in older firm, not gelatinous. Adheres to paper.

South Australia (Investigator Strait, Eastern Bays), West Australia, Tasmania.

Callithamnion spinescens Kützinger.

Fronds slender, 6 cm. to 7 cm. high, primary and secondary branches distichous, everywhere clothed with minute verticillate ramelli; branches distant, patent, divaricate, subdichotomous, spinescent. Articulations of primary branches three to four times as long as broad, ramelli twice as long as broad. Tetrasporangia oblong, sessile at nodes of ultimate ramuli, hyaline, triangularly divided.

South Australia (Eastern Bays).

Callithamnion Muelleri Sonder.

Frond dwarf, caespitose, widely branched, intricate, verticillate, densely pinnate; pinnae regular, very short, lower ones constricted, rigid, subacuminate, simple, upper ones curved in, pinnulated, the pinnellae few and obtuse. Tetrasporangia secund, on the upper side of the pinnae, triangularly divided.

South Coast of Australia (parasitic on Fucoids).

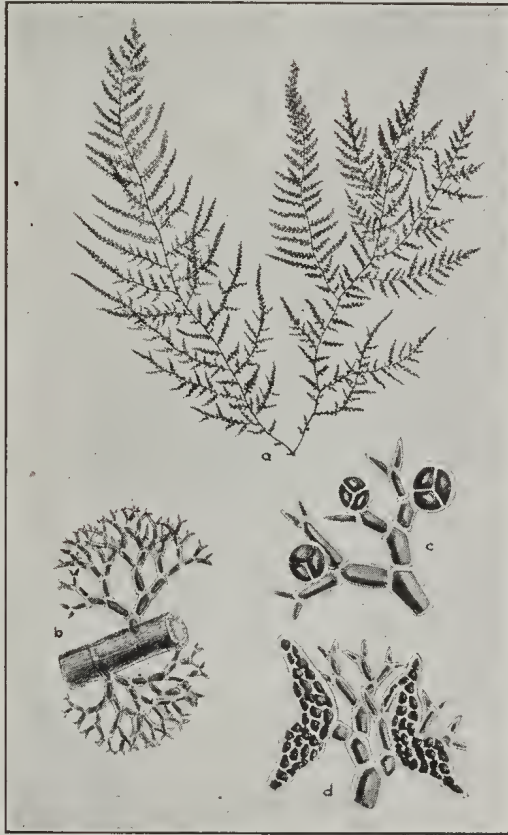


Fig. 161.—*Callithamnion laricinum*: a, plant; b, portion of a branch, with dichotomous ramuli; c, apex of a ramulus bearing tetraspores; d, apex bearing favellae. (After Harvey.)

Callithamnion pulchellum Harvey.

Frond minute, creeping; larger ramuli free at the apices, slightly branched, oppositely densely pinnate; pinnae in pairs, regularly distichous, with distichous pinnellae, very simple, thick, subacuminate; articulations twice as long as wide; articulations of the pinnae and pinnellae shorter. Cystocarps simple, on the rachis at the apices of the plumules. Tetrasporangia transformed from the pinnellae.

South Australia (Investigator Strait, Eastern Bays), West Australia.

Callithamnion longinode Harvey.

Frond very slender, pellucid, articulate, irregularly dichotomous, subfastigiate, with acute axils, apices attenuated; articulations many times longer than they are wide, cylindrical.

Victoria (Warrnambool).

Callithamnion ovuligerum Asken.

Frond epiphytic, ecorticate, the ramuli regular, with filaments at the articulations, or verticillate, shortly articulate; ramelli unicellular, ellipsoid, or ovate. Tetrasporangia carried singly on the primary articulations of the ramuli, sessile. Cystocarps on the primary filaments, aerogenous, the young ones involute on the filaments of the ramuli, the fully developed ones naked and divided into many sections.

South Australia (Holdfast Bay).

Subfamily Spongoclonieae Schmitz.

KEY TO THE GENERA.

- a. Fronds terete *Spongoclonium*
Sonder.
aa. Fronds complanate *Haloplegma*
Montagne.

SPONGOCLONIUM Sonder.

Frond erect, terete, irregularly branched; ramuli densely spongiöse, the central axis thickened with rhizoids, ecorticate, articulate, alternately laterally branched; ramuli are so branched from the external side that they curl over the axis, forming a thick covering. Cystocarps numerous, scattered over the surface of the frond and hidden with a covering of fine hairs. Tetrasporangia shortly pedicellate, triangularly divided, solitary or in rows. Antheridia thyrsoïd.

Spongoclonium fasciculatum J. Agardh.

Frond wide, caulescent, alternately irregularly branched; ramuli simple, ascending patently, spongiöse, fasciculate, alternate, short, almost attached to the rachis; terminal ramelli of the fascicles conspicuously incurved and thick. Cystocarps numerous, within the fascicles, subconfluent, in a conspicuous cluster.

Victoria (Port Phillip).

Spongoclonium brownianum (Harvey) J. Agardh.

Fronds 8 cm. to 10 cm. high, caulescent, radical from basal articuli of branches, totally stupose and everywhere shaggy; ramelli covered with continuous coalescing strata, irregularly pinnate, pinnae spreading to all sides, apices subcorymbose; lower pinnules patent, subulate, upper extremely incurved; articulations of branches of equal dimensions, of ramuli longer than broad. Cystocarps nidulating within eorymbs of ramelli. Tetrasporangia on lateral pinnules, sparse, shortly pedicellate.

South Australia (Sturt Bay), West Australia.

Spongoclonium Wollostonianum (Harv.) J. Agardh.= *Callithamnion Wollostonianum* Harvey.

Frond 10 cm. to 14 cm. long, wide, caulescent, with the stem at the base thinly corticate for a long distance, above stupose, hirsute, subdistichously branched; ramuli above free pinnate, irregular, with pinnae branching in all directions, sublinear; the pinnellae alternate on the elongated rachis, which is prominent and bare, patent from the horizontal pinnae, the lower ones sparsely pinnulated. Tetrasporangia sparse and shortly pedicellate.

West Australia (King George Sound).

Spongoclonium Wilsonianum J. Agardh.

Frond wide, caulescent, alternately irregularly plumed, plumes spreading in all directions, lanceolate; pinnellae alternate on the elongated rachis, which is prominent and bare, patent from the horizontal pinnae, the lower



Fig. 162.—*Spongoclonium Wollostonianum*.

ones densely branched close to the rachis; incurved ramelli cover the stupose ramuli and stem. Tetrasporangia triangularly divided, scattered on the lower pinnellae.

Victoria (Port Phillip).

Spongoclonium scoparium J. Agardh.

Frond 10 cm. long, caespitose, rotund spreading; ramuli fasciculate, regularly branched again and again, radiating above the stipe, which is less conspicuously funicular; ramuli and ramelli erect, patent, close together, of irregular lengths.

Victoria (Western Port), Tasmania (Orford).

Spongoclonium paradoxum (Harv.) De Toni.= *Callithamnion paradoxum* Harvey.

Frond spongiose, widely branched, growing entirely from very dense intertwined root filaments, pyramidal; lateral ramuli very densely tomentose, simple, or regularly laterally branched, ramelli shortly pinnate;

pinnae alternate, few, very long, flexuous, obtuse. Tetrasporangia on the sides of the pinnellae, sessile, solitary.

Victoria (Warrnambool), Tasmania.

Spongoclonium dasyurum (Harv.) J. Agardh.

= *Callithamnion dasyurum* Harvey.

Frond spongiöse, stupose, bi-tri-pectinate, pinnate, pinnae and pinnellae close together, virgate; decurrent filaments densely intertwined, velate, and even the small ramelli are hirsute; ramelli when young slightly stupose, very dense, alternately plumed; plumes minute, oblong, pectinate-pinnate; pinnellae of the plumes are long, incurved, simple or branched at the base; articulations all very short. Colour intense red.

Victoria (Port Phillip).

HALOPLEGMA Montagne.

Frond sponge-like, expanded, wholly composed of interwoven¹ and anastomosing confervoid filaments; the central filaments longitudinal, subparallel, anastomosing; the superficial short, vertical and free. Cystocarps involucreted, sessile on the network. Tetrasporangia tripartite, borne on the superficial filaments.

Haloplegma Preissii Sonder.

Frond somewhat flabelliform, subdichotomous, lacinated; the segments pinnatifid; pinnules oblique, falcate, fringed on the outer edge; articulations of the filaments two-three times as long as broad.

Attachment a mass of woolly filaments. Frond a flat, sponge-like or cloth-like body, very irregular in shape, 5 cm. to 30 cm. long, and as much in expansion of the segments. The form is so greatly varied that it is difficult to describe, except in general terms. The outline, when young, is generally flabelliform, and in some specimens this form is retained, the fan being but slightly cleft into a few shallow segments; in others the frond is dichotomo-multifid, the main branches not more than 6 mm. wide, or even less; the lesser ones deeply pinnatifid or bi-pinnatifid. In other specimens the lesser branches are deeply lobed on one edge only. All the axils are rounded. The ultimate lobes are very generally falcate, especially the younger ones, and are finely fringed on the outer edges. The spongy body of the frond is composed of several strata of closely interwoven, anastomosing, and subparallel longitudinal filaments, resembling those of *Callithamnion*; the surface is coated with a pile of minute, simple or forked, incurved, subulate, horizontally excurrent ramuli. Favellae are clustered, surrounded by an involucre of many ramuli, and scattered over the surface of the network, on which they form little wart-like prominences. Tetrasporangia are plentifully born on the sides of the ramuli. The colour varies from a livid-purple to a clear rosy-red, and fades through orange to yellowish and tawny. The substance is membranous, but soft, holding water like a sponge. In drying adheres firmly to paper.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia, Tasmania.



Fig. 163.—*Haloplegma Preissii*: a, portion of a frond; b, some of the vertical, anastomosing, central filaments, and the free, horizontal, superficial ramuli, showing their connection; c, ramulus with tetraspores; d, tetraspore; e, involucreted cluster of favellae; f, favella; g, spores. (After Harvey.)

Subfamily Ptiloteae Cramer.

CONSPECTUS OF THE GENERA.

A.—Apical cell obliquely articulate.

Euptilota Kütz. Fronds coated with rhizoids or truly corticated.

Cystocarps terminal on short pinnules.

Rhodocallis Kütz. Fronds truly corticated. Cystocarps terminal on primary branches of the frond.

B.—Apical cell transversely (horizontally) articulate.

Ptilota Ag. Fronds truly corticate. Cystocarps terminal on fertile ramuli.

EUPTILOTA Kützling.

Frond compressed or two-edged, distichous, pectinato-pinnate, inarticulate, with an articulate monosiphonous axis; the pinnules sometimes articulate. Cystocarps involucrate, containing numerous angular spores. Tetrasporangia attached to the pinnules, sessile or stalked, solitary or glomerulate, tripartite.

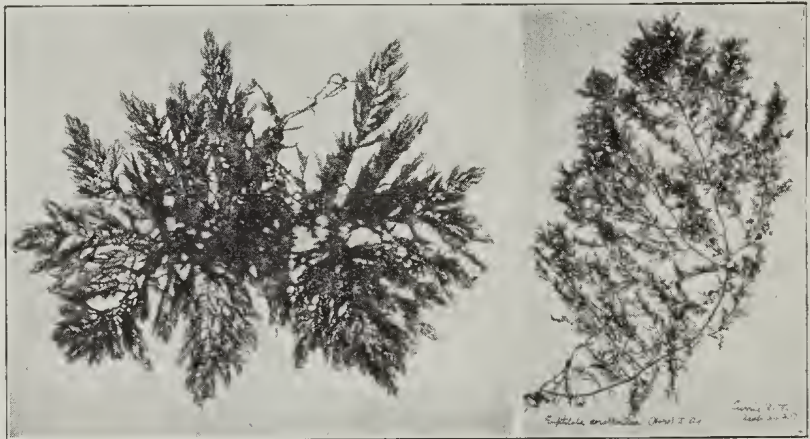


Fig. 164.—*Euptilota articulata*.

Fig. 165.—*Euptilota coralloidea*.

Euptilota articulata (J. Ag.) Schmitz.

Frond irregularly pinnate, pinnae alternate on the ancipitous rachis, pinnellae regular below, with a cellular cortex, their upper parts, as well as the secondary pinnellae, simple articulate; articulations ecorticate; the secondary pinnellae bearing tetraspores are no different in form from the sterile ones. Tetrasporangia borne sparsely at the apices of the pinnellae. Cystocarps developed on the lower regular pinnellae, projecting a little above the pinnae, involucrate on the numerous converging pinnellae.

South Australia (Encounter Bay, Eastern Bays), West Australia, Tasmania.

Euptilota coralloidea (J. Ag.) Kützling.

= *Ptilota coralloidea* J. Agardh.

Frond 10 cm. high, irregularly pinnate, pinnae alternate on the ancipitous rachis, pinnellae corticate almost to the apices, linear, attenuated,

incurved, subdentate; pinnæ short, monosiphonous, pinnate, subcorymbose, with tetraspores scattered at the apices. Tetrasporangia on the outer side of the pinnellæ opposite the denticulations, and arranged in irregular rows amongst the pinnellæ. Colour red or purplish. Substance cartilaginous.

South Australia (Encounter Bay, Eastern Bays), West Australia, Tasmania.

Euptilota Jeannerettii (Harv.) Schmitz.

= *Ptilota Jeannerettii* Harvey.

Frond irregularly pinnate-decompound or subcorymbose-paniculate; rachis two-edged, plano-compressed; branches alternate or scattered, unequal, erecto-patent; pinnules corticate, pectinate, unequal, acute, the uppermost frequently pinnellate. Favellæ with an involucre of articulated, monosiphonous ramelli. Tetrasporangia corymbose-paniculate, terminating one-tubed, articulate ramelli.

Attachment a small disc. Frond 25 cm. long and as much in the expansion of the branches. Stem and branches strongly compressed; main branches irregularly inserted; secondary branches more regularly pinnate,

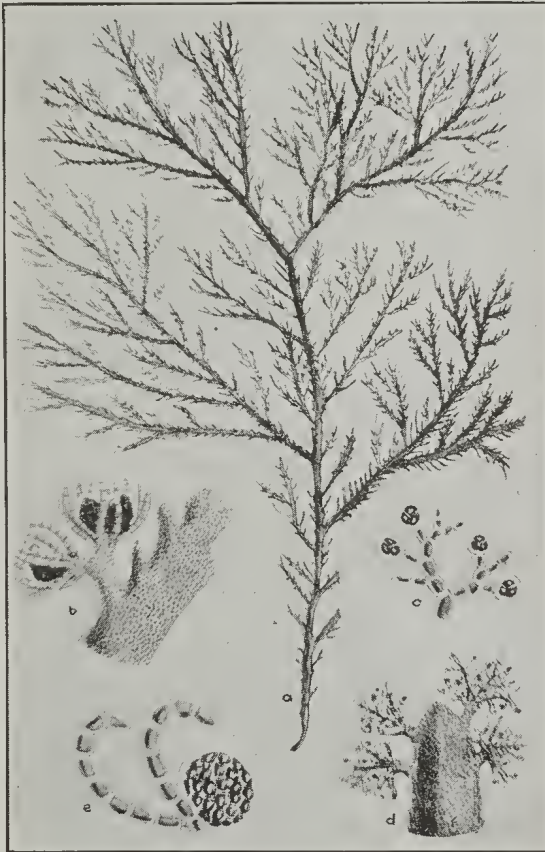


Fig. 166.—*Euptilota Jeannerettii*: a, plant; b, apex of a ramulus, with favellæ; c, portion of one of the tufted ramelli, with tetraspores; d, apex with tufts bearing tetraspores; e, a favella and two of its involucral ramuli. (After Harvey.)

but sometimes nearly bare. Colour dark vinous-red. The favellae are born on minute, lateral pedicels, and are solitary or in pairs, surrounded by a circle of incurved, involueral ramelli. Tetrasporangia are born on minute, lateral, much branched, dichotomous ramelli. Substance rather rigid, adheres imperfectly to paper.

South Australia (Eastern Bays), Tasmania.

RHODOCALLIS Kützting.

Differs from *Euptilota* in having a true cortex and bearing the cystocarps terminally on the primary branches. There is only the one species.

Rhodocallis elegans Kützting.

= *Ptilota Rhodocallis* Harvey.

Frond slender, subcompressed, corticated, alternately twice or three times compounded; branches and their divisions subdistant, rod-like, closely pectinato-pinnate; pinnules alternate, subulate, inarticulate; involuere of several serrated leaflets; tetrasporangia glomerated near the tips of the pinnules.

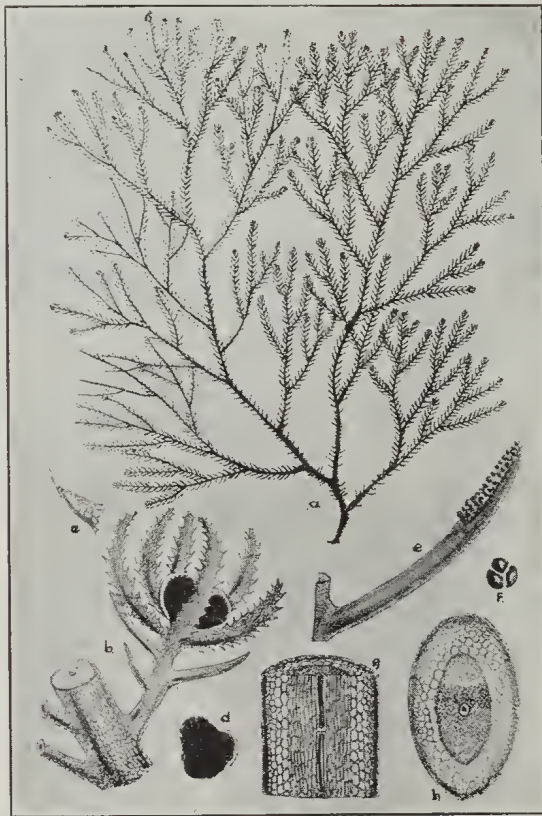


Fig. 167.—*Rhodocallis elegans*: a, plant; b, a branchlet, bearing an involucre favella; c, one of the teeth of the involucre leaflet; d, a favella, removed; e, a pinnule, bearing a cluster of tetraspores; f, a tetraspore; g, longitudinal section of the frond; h, transverse section of the frond. (After Harvey.)

Attachment discoid. Stem for 2 cm. to 5 cm. above base clothed with short woolly hairs; later glabrous. All the axils are acute and the divisions erecto-patent. Every part of the frond is elegantly pectinated with short, alternate, acute ramuli about 2 mm. long. The axile tube is slender, surrounded by a double, very thick cortical layer. The favellae terminate abbreviated lateral branchlets, and are surrounded by several serrated ramuli. The tetraspores are very small, and crowded in a dense sorus along the upper edge of the pinnules, near their points. Colour full dark-red. Substance cartilaginous. Does not firmly adhere to paper.

Southern Coast of Australia, Tasmania.

PTILOTA C. Agardh.

Fronds erect, compressed or two edged, pectino-pinnate, inarticulate, with an articulate axis usually corticate with many cells in strata; internal stratum of round cells, interspersed with narrow tubes, thin or thick; cortical of minute vertical cells. Apical cell transversely septate. Cystocarps formed on terminal pinnules, often involucreted with conjoined or separate ramelli; producing many hyaline, angular carpospores within the

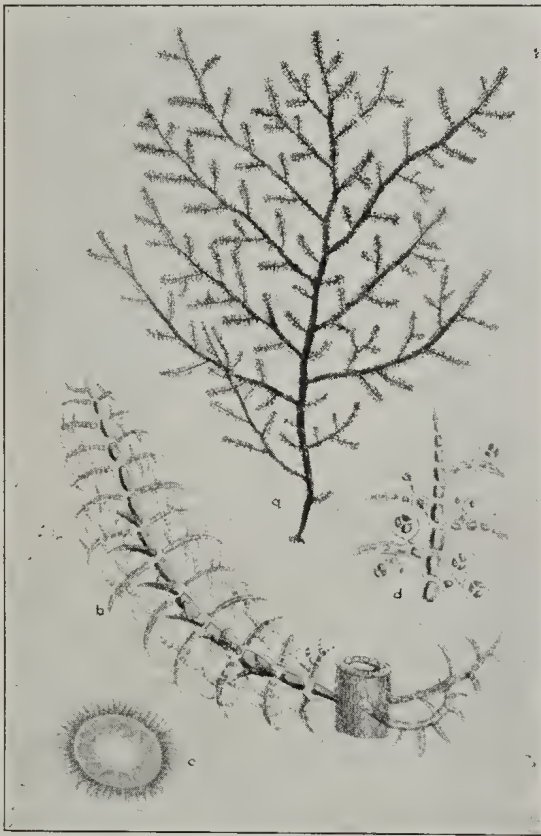


Fig. 168.—*Ptilota Hannafordii*: a, plant; b, a pinna, with its opposing abortive pinnae; c, section through the stem; d, pinnule, bearing tetraspores. (After Harvey.)

pericarp. Tetraspores attached to ultimate, articulate and monosiphonous, pinnules, sessile or stalked, sparse or often aggregated, spherical, triangularly divided.

Ptilota Hannafordii Harvey.

Frond terete, velvety, irregularly bipinnately branched; branches unequal, alternate, closely set with minute squarrose, subbipinnate pinnae; pinnae articulate, alternate, opposed by one to two small ramuli distichously, tri- or tetrastichously bipinnate, the ultimate pinnules subulate, and recurved, articulate. Tetraspores globose, subsessile on the ultimate pinnules.

Attachment or holdfast a disc. Frond 10 cm. to 20 cm. high, having a percurrent stem and distichous, spreading, laxly-pinnated branches. The stem and all the larger and older branches are covered with a velvet-like pile of minute jointed hairs; young branches glabrous. The pinnae are articulated and whorled with ternate pinnules; the pinnules are recurved and sharp-pointed. Tetrasporangia globose, on very short pedicels, lateral on the ultimate pinnules, ternately partite. Colour dark-brownish or full-red. Substance firm and cartilaginous; does not adhere to paper.

Victoria (Port Fairy, Warrnambool).

Subfamily Dasyphileae.

KEY TO THE GENERA.

- a. Fronds terete or slightly compressed.
 - b. Fronds terete or slightly compressed, densely pilose, lower ramuli short, verticillate, not free *Dasyphila* Sonder.
 - bb. Fronds terete. Ramuli shortly verticillate, everywhere free *Muellerena* Schmitz.
 - aa. Fronds ancipitous-plane, superficially glabrous, ramuli shortly verticillate *Psilothallia* Schmitz..

DASYPHILA Sonder.

Frond filiform, distichous, decompound-pinnate, inarticulate, fibroscellular, with an articulated monosiphonous axis; the surface densely clothed with articulated, free, hair-like ramelli. Favellae involucrate, terminating short branches, and containing numerous angular spores. Tetrasporangia tripartite, formed at the tips of investing ramelli.

Dasyphila Preissii Sonder.

Frond filiform, distichous, decompound-pinnate, inarticulate, fibroscellular, with an articulated monosiphonous axis; the surface densely clothed with articulated, free, hair-like ramelli.

Attachment discoid. Frond 7 cm. to 15 cm. long, filiform, opaque, covered with minute hair-like ramelli. The ramification is distichous, the branches and their divisions being all alternate. The pinnæ and pinnules are patent; the axils obtuse; and the ultimate pinnules subulate 2 mm. to 4 mm. in length. The ramelli are minute, irregularly branched, articulate, confervoid, joints scarcely twice as long as broad. The stem is as follows:—A single axial tube of large diameter, articulated and containing endochrome, runs through the whole frond; round this are densely

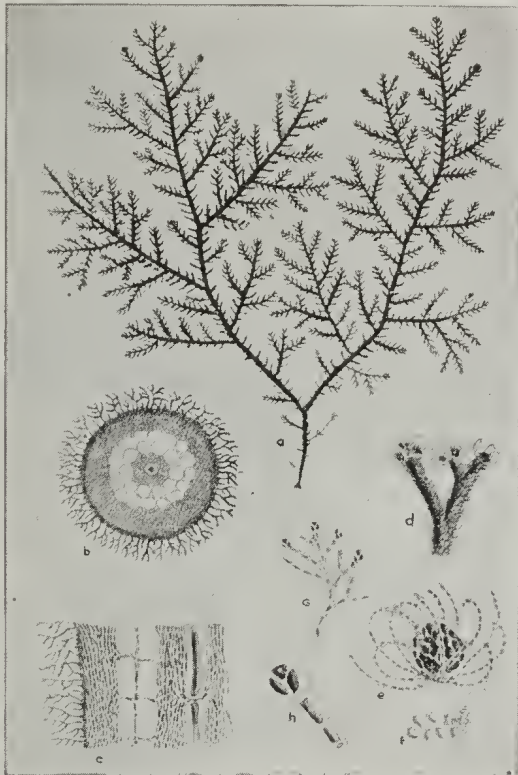


Fig. 169.—*Dasyphila Preissii*: a, plant; b, cross-section of branch; c, longitudinal semi-section; d, tips of branches bearing favellae; e, favella with involucreal ramelli; f, spores; g, ramellus with tetraspores; h, one of its fertile segments. (After Harvey.)

packed innumerable longitudinal, articulated, coloured filaments; then a single, double or triple circle of larger longitudinal filaments; and lastly the cortical layer, composed of slender filaments similar to those that invest the axis, and externally emitting the free horizontal ramelli that form the velvety surface. The favellae are borne two or three together on the tips of short branches, where they are densely involucreated with slender, hair-like, incurved ramelli. The tetraspores occur abundantly, on separate individuals, on the tips of the ramelli. Colour dark red-brown; substance rigid; does not adhere well to paper.

South Australia (Encounter Bay, Eastern Bays), West Australia, Tasmania.

MUELLERENA Schmitz.

Fronds erect, terete, abundantly branched in one plane, lateral branches regularly distichous, alternate, crescentic or symmetrically branched. Central axis articulate, thick; ramuli covered with whorls of free ramelli in fours, at length densely corticated externally by rhizoids, becoming shortly pilose. Cystocarps minute, imperceptible, situated in lower parts of lateral branches on the fertile verticils, all involucrate with verticillate ramuli. Gonimoblasts evolved successively from many round gonimolobes. Tetrasporangia sparse, terminal on ramelli of verticillate branches, triangularly divided.

Muellerena Wattsii (Harv.) Schmitz.

= *Crouania Wattsii* Harvey.

Frond cartilaginous, thickly corticated throughout, opaque, dichotomous, bi-tri-pinnate; pinnae and pinnules alternate, close, horizontally spreading, whorled at the nodes with minute, dichotomo-multifid, four ranked, articulated, mucronate ramelli; tetrasporangia globose, sessile. Frond 4 cm. to



Fig. 170.—*Muellerena Wattsii*: a, plant; b, one of the pinnules, whorled with ramelli; c, cross-section of the pinnule, through one of the whorls; d, part of a ramellus; e, a tetraspore from the same; f, cross-section of a branch. (After Harvey.)

6 cm. long, distichous, with a pyramidal outline, the lowest branches being longest, the upper gradually shorter, main stem undivided, closely pinnated throughout with alternate, horizontal lateral branches. Branches bare of pinnulae at base for nearly one-third of length. Every part of the frond is closely whorled with minute quadrifarious ramelli, the whorls nearly touching. The branches, pinnae, and pinnules are all opaque, being corticated with a layer of cellules, which is thickest in the oldest parts, Tetrasporangia globose, sessile near the tips of the ramelli. Colour deep red. Substance rather cartilaginous, soft. Adheres to paper.

Victoria (Warrnambool).

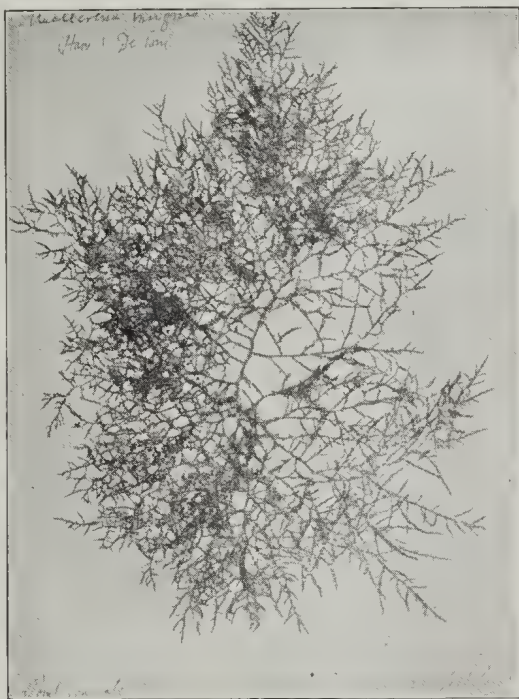


Fig. 171.—*Muellerena insignis*.

Muellerena (?) *Agardhiana* (Harv.) De Toni.

= *Crouania Agardhiana* Harvey.

Frond cartilaginous, thickly corticated, opaque, much branched; branches and ramuli alternate, repeatedly divided, very patent, whorled at the nodes with minute, dichotomo-multifid, four-ranked, articulated, obtuse ramelli; favellae quaternate, at the apices of short branches.

Attachment a small disc. Frond 12 cm. to 20 cm. long, about 1 mm. thick, coated with a layer of peripheric cells, in the younger in a single row, in the older in three or four rows, surrounding the monosiphonous, articulated axial tube. The frond is much branched in an irregular manner, branches and ramuli spreading at wide angles. The internodes throughout the frond are about one and a half to two times as long as broad. The nodes are whorled with quaternate ramelli. These ramelli are minute with blunt apices and three to four times dichotomous. Favellae mostly four together, at ends of the ramuli, each containing several angular spores

in a hyaline periderm. Colour red. Substance cartilaginous, much firmer than others of the genus. Adheres to paper.

West Australia (King George Sound).

Muellerena (?) *insignis* (Harv.) De Toni.

= *Crouania insignis* Harvey.

Frond 20 cm. to 30 cm. long or more, attenuated above, pyramidal, irregularly branched, ramuli patent, verticillate at the joints, below verrucose, with prominent rings of nodes, apices spongiöse, almost confluent, ramelli verticillate, the inner ones curving from whorl to whorl and covering every part of the frond, forming an intricate corticate tube like a net; the outer ramelli are free, rigid, conspicuously attenuated towards the apices. Articulate. Substance rather cartilaginous. Colour purple-brown.

South Coast of Australia, Tasmania.

PSILOTHALLIA Schmitz.

Fronds erect, plane and almost two edged, soft, alternate, distichous, shortly pinnulate; central tube articulate (apical cell transversely divided) ramelli filiform disposed in four or five verticils; cortex dense, completely surrounding central axis. Tetrasporangia situated on short, lateral, upper ramuli, on the ends of monosiphonous, subdivided ramelli. Cystocarps as in *Dasyphila*, on heteromorphic pectinate ramelli.

Psilothallia striata (Harv.) Schmitz.

= *Ptilota striata* Harvey.

Frond slender, two-edged, alternately decompound; branches and their divisions subdistant, rod-like, transversely rugulose, closely pectinato-pinnate; pinnules alternate, subulate, inarticulate, transversely striate.

Attachment or holdfast, a large flattened disc. Fronds tufted or solitary, 15 cm. to 30 cm. long, compressed and sharply two-edged, alternately and irregularly branched. Branches three or four times decompound, divisions, erecto-patent, issuing at acute angles of unequal length. All branches closely pinnulated with minute alternate pinnules, 2 mm. to 4 mm. long. The favellae are very minute, sessile near the tips of the pinnules and surrounded by confervoid, articulated, strongly involute filaments. The tetrasporangia are borne on the ends of the branches of minute confervoid filaments, which issue from either edge of the pinnules. Colour dark-red. Substance cartilaginous. Adheres imperfectly to paper when dry.

West Australia (Rottnest Island).

Psilothallia (?) *siliculosa* (Harv.) Schmitz.

= *Ptilota siliculosa* Harvey.

Frond irregularly pinnate, pinnae alternate on the ancipitous rachis, which is prominent and ribbed; pinnellae corticate to the apices, acuminate, close together, entire. Tetrasporangia carried in irregular rows on the upper margin of the pinnellae, short and almost spongiöse; minute incurved articulate filaments rise from the surface enclosing tetraspores singly at the base with their incurved apices. Cystocarps are found singly at the inner margin, below the apices, sessile, globose.

West Australia (Rottnest Island).

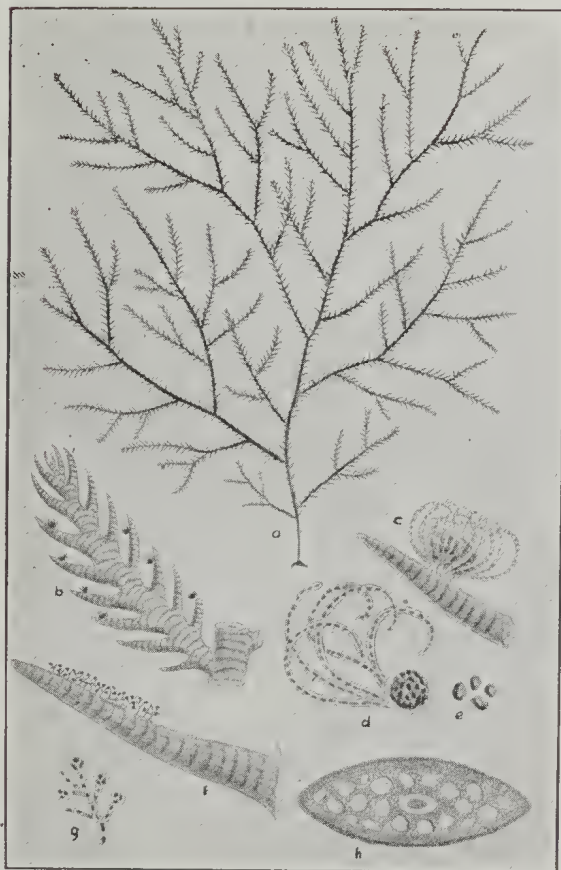


Fig. 172.—*Psilothallia striata*: a, plant; b, a small branch bearing favellae on its pinnules; c, apex of a pinnule, with an involucred favella; d, the favella, with a portion of the involucre removed; e, spores; f, a pinnule, bearing marginal confervoid filaments, with tetraspores; g, one of the fertile filaments; h, transverse section of the frond. (After Harvey.)



Fig. 173.—*Ballia Robertiana*: a, plant; b, two pairs of opposite, alternately unequal, plumules; c, pinna from one of the major plumules; d, an involucre containing a favella; e, favella removed; f, spores. (After Harvey.)

Subfamily Crouanieae Schmitz.

CONSPECTUS OF THE GENERA.

I.—Fronds slender, filamentous, principal filaments confervoid in a single series of cells.

Ballia Harvey. Cystocarps in axils of short branches.

Antithamnion Nacgeli. Cystocarps terminal.

II.—Fronds terete, central axis bare or corticated with rhizoids. Ramelli short, passing out from axis, cohering together with mucous.

Crouania J. Agardh. Central axis bare or moderately corticated. Short verticillate ramuli from axis growing out separately or together.

Lasiothalia Harvey. Central axis soon densely covered with rhizoids and then inconspicuous. Fronds pilose, piles emerging from a mucous stratum.

III.—Fronds thick, complanate, central axis densely corticated.

Gattya Harvey. Cortical stratum of cells constantly monostromatic.

Ptilocladia Sonder. External cortical stratum densely cellular in anticlinal series, internal lax.

BALLIA Harvey.

Frond filiform, rigid, dendroid; the stem and branches covered with a plexus of hair-like, short fibres; ramuli pellucidly articulate, pinnately decom-pound. Involucrate favellae terminating short pinnae and containing numerous angular spores. Tetrasporangia born on the hair-like fibres of the stem and branches.

Ballia Robertiana Harvey.

Attachment an expanded disc. Fronds tufted, 6 cm. to 15 cm. long, distichous, decom-pound-pinnate, the main branches and lesser divisions opposite, patent, subdistant. Stem and branches densely clothed with short, rigid, hair-like filaments, which throw out rhizoids that are woven round the branches in an inextricable plexus. The ends of the branches are pellucidly articulate, the articulations cylindrical, not contracted at the joints or obovate (as in *B. callitricha*), and are distichously plumulate throughout. The articulations of the rachis are cylindrical; its ovate pinnae are so closely pinnulated that the parallel pinnules touch each other through almost their whole length, and the pinna looks like a leaflet. Tetrasporangia are borne on the stupose fibres of stem and branches. Favellae surrounded by numerous inrolled, elongate, branched involucral ramuli, borne on shortened branches. Colour dark brownish-red. Substance rigid. Plant adheres to paper scarcely at all.

South Australia (Eastern Bays), Victoria (Port Fairy), Tasmania.

Ballia callitricha (Ag.) Montagne.

Attachment a spongiose disc. Frond sometimes small, sometimes up to 25 cm. long, distichous, irregularly pinnate; pinnae and pinnulae opposite, regular, lanceolate, the lower ones simple and acute; pinnae articulate below, attached to the rachis and decurrent, then branching; ramuli fertile, conspicuously irregular. Colour reddish-purple, darker when dry.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), West Australia, Tasmania, New Zealand.



Fig. 174.—*Baillia callitricha*: Two plants.

Baillia Mariana Harvey.

Penultimate branches incurved, tristichous, all but one very short and irregularly multifid or pinnate; the long branch closely pinnated with tristichous plumules; these plumellae patent, pinnate, with excurrent rachis; the ultimate ramuli slender, cylindrical, obtuse, opposite or often secund.

Attachment or holdfast a conical mass of woolly fibres. Fronds solitary, 14 cm. to 20 cm. long or more, distichously branched; principal branches irregular, alternate or scattered. Branches pinnated throughout with minute and larger plumose ramuli, which are alternately inserted along each rachis. Two to four or six of these plumules, placed approximately opposite at intervals of about $1\frac{1}{2}$ cm., are branch-like, 1 cm. to 3 cm. long

and plumulate as the branches; the rest are 4 mm. to 6 mm. long and incurved. Circling the branch at each node are three or four small and irregularly divided ramuli. The alternating plumules have a filiform rachis of cylindrical cells three to four times longer than broad and closely whorled with tristichous pinnae. Articulations of the ultimate ramuli as long as broad; apices blunt. Colour deep red. Substance firm and rigid. Does not adhere well to paper.

South Australia (Eastern Bays), Victoria (Warrnambool, Port Fairy).

Ballia scoparia Harvey.

Frond widely branched, caespitose, 15 cm. to 50 cm. long; ramuli and ramelli irregularly fasciculate; secondary ramelli much thinner, hirsute, subsecund below the apices, spinous, finally fertile, bearing fruit on the lower part or above the axils. Tetrasporangia subsecund, grouped. Colour brownish-purple; substance rigid.

South Coast of Australia, Tasmania, New Zealand, Pacific Ocean.

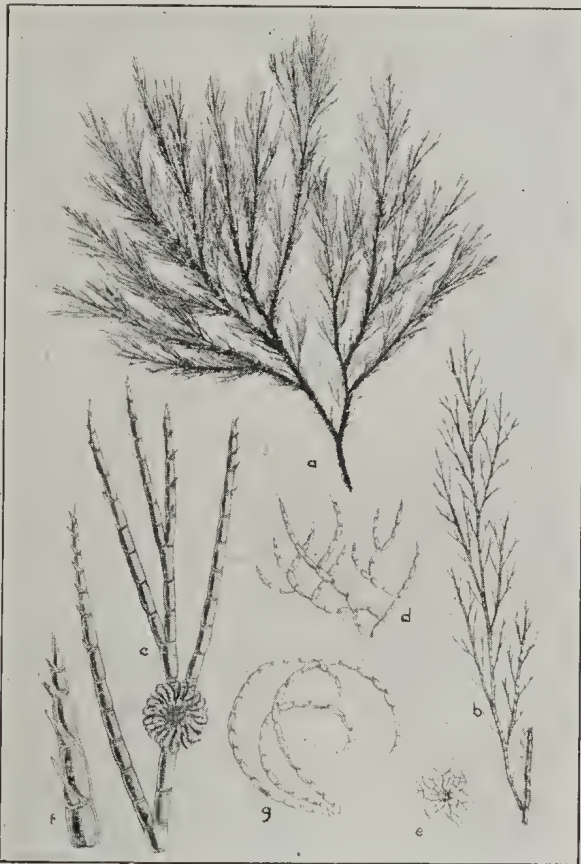


Fig. 175.—*Ballia scoparia*: a, plant; b, a penultimate branch; c, section of the stem, with its stipose fibres; d, one of the fibres; e, ramuli, with an involucre; f, apex of a ramulus; g, some of the involucre filaments. (After Harvey.)

Ballia hamulosa J. Agardh.

Frond widely branched, ramuli and ramelli spreading in all directions, lower ones subspongiose, upper ones conspicuously articulate; ramelli opposite or subalternate, simple or dichotomous at the base, patent, acute at the apices, very attenuated. Tetrasporangia on inner side of the ramelli, triangularly divided, firmly attached to the ramelli. Cystocarps thickly covering the ramelli, large, globoscreniform. Colour reddish-brown.

South Australia (Eastern Bays), Victoria.

ANTITHAMNION Nacgeli.

Frond filiform, branched, articulated, monosiphonous, the stem and branches, in many species, at length thickened internally, or coated externally with decurrent filaments; ramuli always pellucidly articulate and monosiphonous. Cystocarps sessile or axillary on the branches, naked, containing numerous angular spores. Tetrasporangia naked, sessile or pedicellate, on the ramuli, triangularly divided.

Antithamnion verticale (Harv.) J. Agardh.

= *Callithamnion verticale* Harvey.

Frond minute, creeping; larger ramuli free at ends, sparsely branched, opposite, densely pinnate; pinnae regular, distichous, alternately pinnulated, parallel with rachis; pinnellae subdistichous, furcate, dense, acuminate. Tetrasporangia single at the ends of the pinnellae.

South Coast of Australia.

Antithamnion horizontale (Harvey) J. Agardh.

Fronds minute, major branches at length freely branched, oppositely densely pinnate; pinnae almost collateral, distichous, alternate, pinnulate, pinnules diverging on every side, furcate, thick, acuminate; articulations of branches slightly shorter than broad, of pinnae equal. Tetrasporangia on terminal pinnules, single.

South Australia (Eastern Bays).

Antithamnion (?) *Hanowioides* (Sond.) De Toni.

= *Callithamnion Hanowioides* Sonder.

Frond minute, creeping; larger ramuli free at the ends, sparsely branched, opposite, densely pinnate; pinnae regular, distichous, sub-collateral, alternately pinnulated; pinnellae spreading in all directions over the ramuli, densely pinnulated, acuminate. Tetrasporangia on the lower pinnellae, sessile, cruciate.

South Australia (Sturt Bay), West Australia.

Antithamnion plumula (Ellis) Thuret.

Frond 10 cm. to 25 cm. long, subdistichous, widely branched at the articulations; ramelli opposite or verticillate, irregular, pinnulated; pinnellae are numerous, branched, secund, spinous. Cystocarps large, grouped on the upper ramelli, surrounded by pinnellae. Tetrasporangia elliptical or globose, large, numerous, developed on the pinnellae on the

upper part of the frond, sessile, rarely pedicellate, cruciate or transversely divided. Antheridia pedicellate, furcate, in the same position as the tetraspores, thyrsoïd.

South Coast of Australia, Tasmania, New Zealand, Atlantic, Mediterranean, Cape Horn.

Antithamnion nodiferum J. Agardh.

= *Callithamnion nodiferum* J. Agardh = *Callithamnion simile* Harvey pars.

Frond subsolitary, robust, rigid, much branched; branches alternately decom-pound, articulated, ecorticate, at length hirsute, oppositely pinnate at every joint; pinnae minute, horizontally patent or recurved, pectinated above, more or less secundly compound; tips of ramuli acute.

Attachment discoid, afterwards a conical mass coated with curled fibres. Fronds erect 2 cm. to 14 cm. high, solitary or few together, distichously much branched; branches alternate, patent, several times divided. All parts of the frond are, at first, pellucidly articulate; in the older fronds the main stem and lower branches are coated with short curled fibres, and become not only opaque but nearly 1 mm. in diameter. Every articulation of the frond emits two or four opposite pinnae, not more than 1 mm. long, spreading horizontally, at nearly right angles with the branches. and hooked back at the point. Apices of the pinnules acute. Colour crimson-red. Substance not very soft. Adheres imperfectly to paper.

South Australia (Eastern Bays), Victoria (Port Fairy).

Antithamnion nigrescens J. Agardh.

Frond erect, 6 cm. to 10 cm. high. Somewhat widely branched, densely pinnulated, opposite, distichous, pectinate; the pinnae at the base are pectinate-pinnulate, pinnellae at the joints are short and incurved, sparsely branched, except below, simple, articulate. Colour dark-red, almost black when dry.

Victoria (Port Phillip).

Antithamnion dispar (Harv.) J. Agardh.

= *Callithamnion dispar* Harvey.

Frond pellucidly articulate, capillary, more or less pinnate, distichous; primary branches few, unequal, virgate, bipinnate; pinnae opposite, spreading, unequal, one shortened, the other long and pinnulated; pinnules opposite, equal, horizontal, thick, multifid, mucronate. Tetrasporangia sessile on the sides or ends of the pinnules.

Attachment a small disc. Fronds solitary or few together, 2 cm. to 8 cm. high, irregularly branched, distichous, pellucidly articulate throughout. Branches opposite, alternate, lateral, very unequal in length, long and short intermixed, simple, virgate, erecto-patent; when not opposite each is opposed by a small ramulus. Both primary and secondary branches are furnished at every joint with minute, multifid, dichotomous whorled ramuli,

whose articulations are very short, the terminal cellules acute. Articulations of the branches oblong, nearly twice as long as broad. Tetrasporangia globose, near the ends of the ramuli, sessile. Colour red-brown. Substance firm, adheres closely to paper.

Victoria (Warrnambool, Port Fairy), Tasmania.

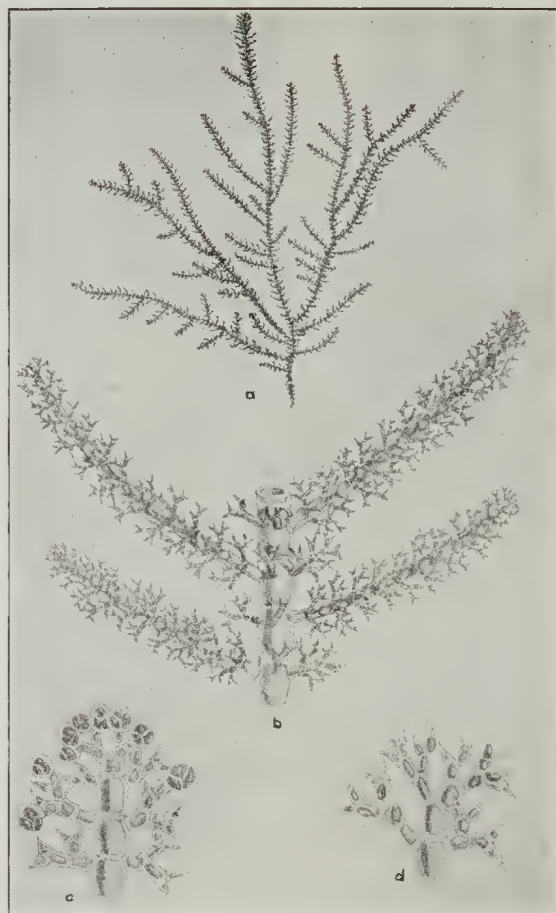


Fig. 176.—*Antithamnion dispar*: a, plant; b, portion of a branch with its unequal ramuli, a long ramulus opposing an abortive one; c, ramellus bearing tetraspores; d, ramellus bearing antheridia. (After Harvey.)

Antithamnion gracilentum (Harv.) J. Agardh.

= *Callithamnion gracilentum* Harvey.

Frond dwarf, creeping, ramuli slender, free at the apices, oppositely pinnate; pinnae distichous, almost regular, lower ones opposite, upper ones alternate; the pinnellae arcuate, pinnulated, simple.

West Australia (Rottnest Island).

Antithamnion divergens (J. Ag.) De Toni.

= *Callithamnion cruciatum* Harvey.

Frond caespitose, filaments erect, sparsely branched, apices densely ocellated; pinnules, pinnae and pinnellae opposite or verticillate, soft, the lower ones horizontal and distant, the upper ones close to the apices of the ramuli, corymbose, divergently pinnulated, the lower ones opposite, upper ones alternate.

South Australia (Encounter Bay), Victoria (Sealer's Cove), Tasmania.

Antithamnion mucronatum (J. Ag.) De Toni.

= *Callithamnion mucronatum* J. Agardh.

Frond 10 cm. to 30 cm. long, elongate, irregular, ramuli spreading, strongly articulate, the younger ones with dense ocellated pinnules; pinnules opposite or in groups of three, soft, the lower ones patent, distant, and mainly simple, the younger one grouped close to the apices of the ramuli, corymbose, acuminate. Tetrasporangia on the inner side of the pinnellae, secund, many at each articulation, cruciate.

South Australia (Investigator Strait), West Australia, Victoria, Tasmania.

Antithamnion (?) *delicatulum* (Harv.) De Toni.

= *Callithamnion delicatulum* Harvey.

Frond dwarf, arachnoid, primary filaments creeping, secondary filaments erect, sparsely branched, plumed; plumes opposite, rising from the articulations below the apices, with fine pinnae widely spaced; the lower pinnellae often opposite, the rest alternate, rising from the flexuous rachis, all attenuated and simple, either with one or two ramuli.

West Australia (King George Sound).

CROUANIA J. Agardh.

Frond filiform, gelatinous, articulate, irregularly branched, and verticillately sub-branched at the articulations, monosiphonous, glabrous or fibrous; articulations short, within the outer cortex; sometimes the central axis is thick and articulate; ramuli furcate, verticillate; the ramelli of the verticils arcuate, curving back to the stem, covering it, articulations one and half times as long as broad. Cystocarps on the shortest ramelli, sublaterally supported, or at the apices of the longer ones, surrounding the ramelli, carrying globose carpospores within the hyaline pericarp. Tetrasporangia are formed from the changed ramelli, sessile, spherical and triangularly divided, sometimes oblong, and transversely subdivided into sections.

Crouania australis (Harv.) J. Agardh.

= *Callithamnion attenuata* var. *australis* Harvey.

Frond attenuated, pyramidally branched and verticillately sub-branched, below moniliform, distantly verticillate; between the nodes, hyaline, ecorticate, the apices of the verticils subconfluent, the verticillate ramelli rigid, divaricate, repeatedly tri-dichotomous, conspicuously attenuated towards the apices.

South Coast of Australia, Tasmania.

Crouania Muelleri Harvey.

Frond rigid, not gelatinous, pellucid, articulate, ecorticate, irregularly densely branched, the ramuli and ramelli attenuated, distantly verticillate; secondary ramelli minute, bearing tetraspores, dichotomous, multifid, obtuse.

Victoria (Western Port, Phillip Island).

Crouania vestita Harvey.

Frond 5 cm. to 15 cm. long, attenuated above, pyramidally branched, verticillately sub-branched, below subspongiose; the ramelli of the verticils

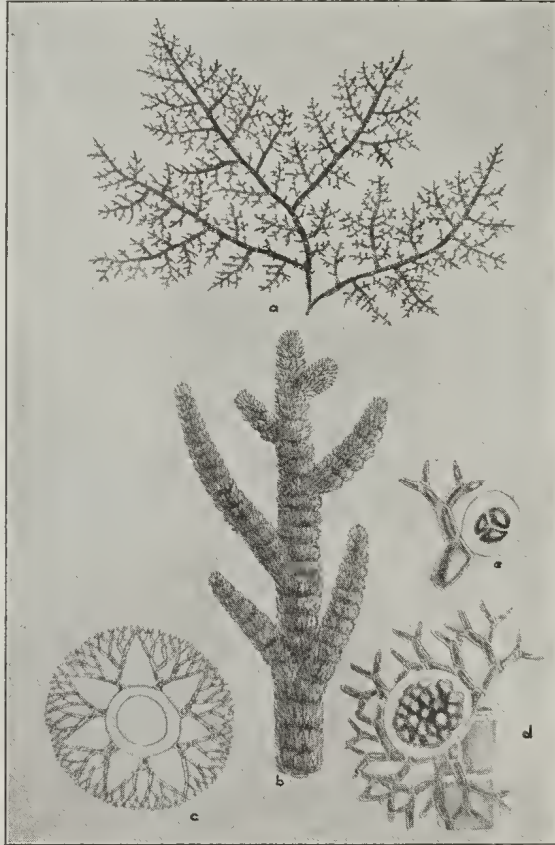


Fig. 177.—*Crouania vestita*: a, plant; b, apex of a branch; c, transverse section, at a node; d, favellae (partly) surrounded by ramelli, some removed; e, a tetraspore on a portion of a ramellus. (After Harvey.)

divergent, the inner ones subarcuate, curving from whorl to whorl, and covering every part of the frond, forming an intricate, ecorticate network, the outer ones free, rigid, conspicuously attenuated towards the apices; articulations cylindrical. Cystocarps globose, furnished with a large hyaline pericarp. Tetrasporangia spherical, triangularly divided. Colour dark red-brown, lighter towards apices. Substance soft, spongiose not very gelatinous.

South Australia (Investigator Strait), West Australia (Rottnest Island, Fremantle, King George Sound).

LASIOTHALIA Harvey.

Frond filiform, branched, articulated, monosiphonous, the stem and branches (in many species) at length thickened internally or coated externally with decurrent filaments; ramuli always pellucidly articulate and monosiphonous. Cystocarps generally in pairs, sessile on the branches, naked, containing numerous angular spores. Tetrasporangia naked, sessile or pedicellate, distributed on the ramuli, triangularly divided.

Lasiotalia hirsuta Harvey.

= *Spongoclonium conspicuum* Sonder.

Frond about 20 cm. or more long, wide, caulescent, with the stem from the attachment and the ramuli almost entirely stupose, hirsute; the ramuli penicillate, free at the apices, widely branched; ramelli incurved, articulations longer than wide. Tetrasporangia sparsely carried on the sides of the ramelli.

South Coast of Australia, Tasmania.

Lasiotalia (?) *plumigera* (Harv.) De Toni.

= *Callithamnion plumigerum* Harvey.

Frond spongy, three or four times pinnate, the pinnae and pinnules covered with interwoven, articulated filaments, and hairy with minute, forked ramelli; ultimate ramuli free, alternately plumulate; plumules minute, pinnato-multifid. Favellae in pairs, sessile. Tetrasporangia globose, secund on the divisions of the plumules.

Attachment covered with woolly fibres. Frond three or four times pinnated, of a soft spongy texture, the primary, secondary, and tertiary pinnae externally clothed with minute, horizontal, subsimple, jointed hairs or ramelli. These hairs spring from numerous longitudinal interwoven filaments, enclosing as in a sheath the proper or primary filamentous frond, which runs as a jointed axis through every portion of the spongy branches. The primary filament has the structure of an ordinary *Callithamnion*; its naked tips are set with alternate, secundly multifid plumules, not more than 4 mm. to 6 mm. long. Favellae are hidden among the superficial hairs, which cluster round them as involucre; they are in pairs and contain many spores. Tetraspores secund along the inner face of the division of the plumules. Colour red to purple. Substance flaccid. Adheres to paper.

Victoria (Port Fairy, Western Port).

Lasiotalia (?) *formosa* (Harv.) De Toni.

= *Callithamnion formosum* Harvey.

Attachment a small callous disc. Frond 25 cm. to 50 cm. long, stupose, hirsute, distichous, alternately branched; ramuli above free, pinnate, irregular; the pinnae spreading in all directions, sublanceolate, the pinnellae alternate on the elongated rachis, which is prominent and glabrous; erect, patent, almost all pinnulated. Tetrasporangia subsolitary, regular on the pinnellae, sessile. Colour light rosy-brown; substance soft, but not gelatinous; adheres to paper.

South Australia (Investigator Strait), Victoria (Port Phillip).



Fig. 178.—*Lasiiothallia plumigera*: a, plant; b, section through the spongy frond, showing the central filament and its surrounding accessories, with the peripheric hairs; c, some of the hairs; d, a pair of plumules; e, one of their pinnules, with tetraspores. (After Harvey.)

Lasiothalia (?) *superbiens* (Harv.) De Toni.

= *Callithamnion superbiens* Harvey.

Frond wide, caulescent; stem for a long distance stupose, hirsute, the upper branches free, pinnate, irregular; pinnae spreading in all directions, lanceolate; pinnellae alternate, on the elongate rachis, which is glabrous and prominent, almost all regular and divaricate; secondary pinnellae long and attenuated. Tetrasporangia on inner side of the incurved pinnellae, sparse and sessile. Colour red, very soft. Adheres to paper.

Victoria (Western Port).

GATTYA Harvey.

Frond distichous; pinnatifid, hollow, tubular, with a membranous periphery, and an articulated, monosiphonous axile filament. Axile filament inarticulate, callithamnoid, emitting at each joint whorled, dichotomous ramelli, whose tips, cohering together, form a membranous periphery of the frond.

Gattya pinnella Harvey.

Fronds rising from prostrate sureuli, which are closely attached at intervals by minute discs to the surface of some alga, afterwards free and erect, 2 cm. to 4 cm. high, alternately or irregularly branched. The branches are perfectly distichous, of unequal lengths, long and short occurring together, and all linear in outline and deeply pinnatifid. Pinnules

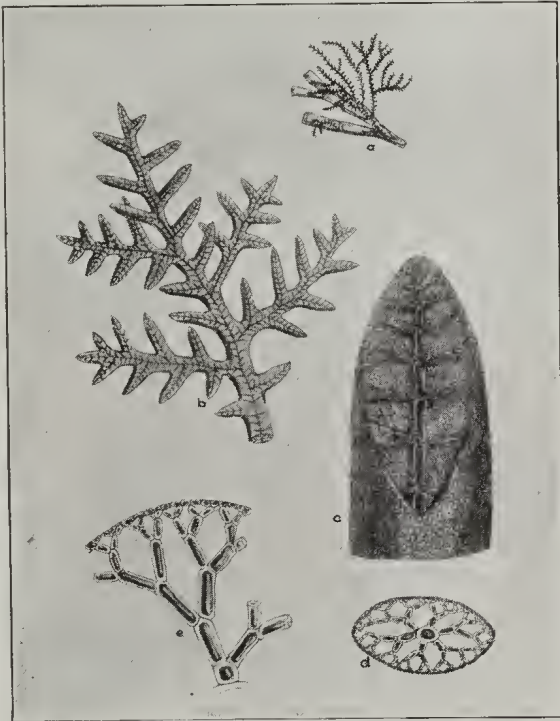


Fig. 179.—*Gattya pinnella*: a, plant; b, portion of frond; c, apex of a pinnule cut open to show axile filament; d, cross-section of same; e, one of the dichotomous, horizontal ramelli. (After Harvey.)

alternate, about 1mm. long, patent, broadly subulate, subacute, with blunt axils. The whole frond is tubular and hollow, but compressed. The tube is traversed by a pointed, monosiphonous, coloured, filamentous axis, at each joint throwing out a whorl of repeatedly dichotomous, horizontal, fastigiate ramelli, whose extremities alone anastomose, and form the enveloping membrane which constitutes the covering of the frond. Colour dark or brownish-red. Substance soft; adheres to paper. Cystocarps acrogenous, forming in the clavate ramuli, often singly, wholly corticate. Tetrasporangia carried on the proliferous ramuli, often at the apices, large in proportion to the size of the plant, triangularly divided.

West Australia (Rottnest Island), Victoria (Warrnambool).

PTILOCLADIA Sonder.

Fronds compressed, pinnately decompound, sponge-like, formed of dichotomous, articulate, interwoven anastomosing ramelli, issuing from a central articulated axile filament; the apices of the ramelli fastigiate, forming the periphery of the frond. Favellae binate, immersed in the ultimate divisions of the frond. Tetraspores tripartite, attached to the peripheric ramelli.

Ptilocladia pulchra Sonder.

Frond compressed, pinnately decompound, sponge-like, formed of dichotomous, articulate, interwoven (and anastomosing ?) ramelli, issuing from a central articulated axile filament; the apices of the ramelli fastigiate, forming the periphery of the frond. Favellae binate, immersed in the ultimate divisions of the frond. Tetraspores tripartite, attached to the peripheric ramelli.

Attachment or holdfast a mass of interwoven fibres. Frond 10 cm. to 15 cm. high; 2 mm. to 6 mm. broad, compressed, distichously much branched; branches irregular, but in a more or less pinnate order; some specimens several times compounded and closely branched; others distantly branched. The texture of the frond is sponge-like, composed of a central, articulated filament or axis, which emits from the centre of every joint numerous small horizontal ramelli. These ramelli are dichotomous, many times forked, their branches closely interlaced together into the spongy mass of the frond. The ramelli forming the shorter diameter (in section) of the compressed frond are simply dichotomous; those that form the longer diameter have a simple rachis, pinnated with dichotomous branches. Favellae in structure quite like those of *Callithamnion*, borne in special processes of the frond which stand out from the smaller pinnules, each on a short pedicel; but these processes are of the ordinary composition of the frond, though homologically to be considered as involucre. Tetrasporangia immersed among the peripheric ramelli of other fronds, attached singly, here and there, near the apex of the ramellus. Colour deep red; substance soft, spongy, when old dry and rigid. Adheres to paper.

South Australia (Eastern Bays), West Australia.

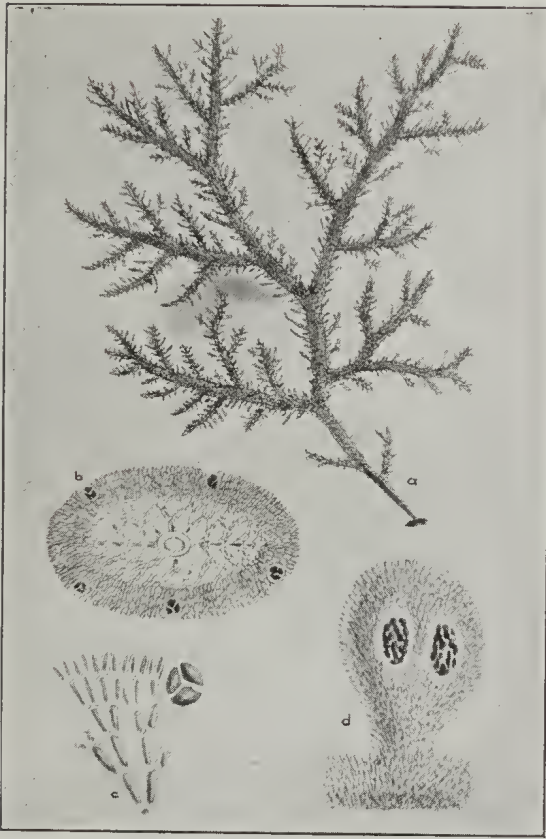


Fig. 180.—*Ptilocladia pulchra*: a, plant; b, cross-section through a branch, showing a section of the central axile filament, the peripheric ramelli and some tetraspores *in situ*; c, apices of a ramellus, with an attached tetraspore; d, external view of one of the ultimate divisions of the frond containing a pair of favella. (After Harvey.)

Subfamily Spyridieae J. Agardh.

SPYRIDIA Harvey.

Frond filiform, pinnately decompound, articulated, but gradually becoming coated with a layer of small, coloured cellules; branches and ramuli furnished with minute, bristle-shaped, articulated ramelli. Cystocarps terminating short branches, involucreted or naked, containing with a closed, membranous pericarp numerous oblong spores. Tetraspores formed along the ramelli, external, sessile, triangularly parted.

Spyridia prolifera Harvey.

Frond robust, tall, rigid, terete, inarticulate, very thickly corticated, sparingly and irregularly branched; branches simple or forked, more or less beset with short, capillary, tufted, branched or simple, ramelliferous ramuli; ramelli setaceous, alternate, acute; tetraspores secund on the ramelli, sessile. Colour of stem and branches dark-red, of the ramuli blood-red. Substance cartilaginous and rather rigid. In drying the stem and branches adhere imperfectly, the ramuli more closely, to paper.

West Australia (Fremantle).

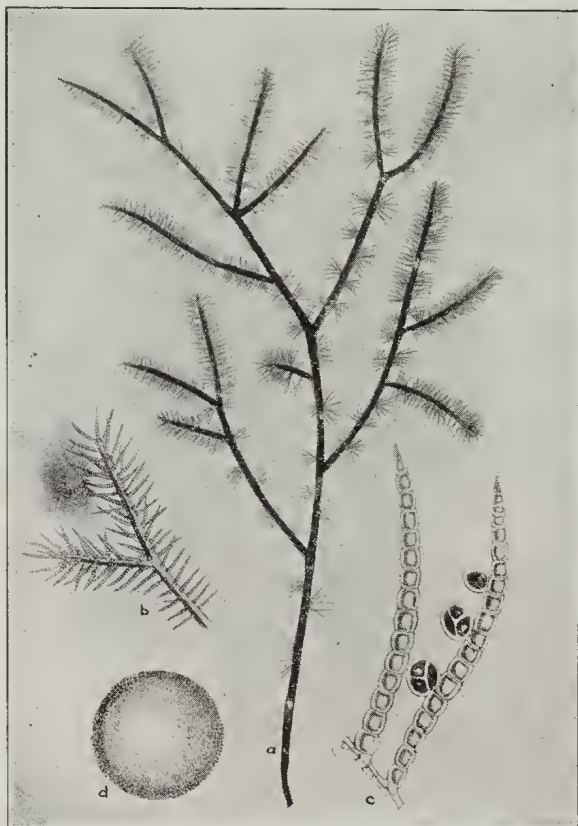


Fig. 181.—*Spyridia prolifera*: a, plant; b, portion of one of the proliferous ramuli; c, ramelli, from the same, one of them bearing tetraspores; d, a transverse section of a branch. (After Harvey.)

Spyridia biannulata J. Ag.

= *Spyridia filamentosa* Harvey pars.

Frond filiform, spreading in all directions, ramuli regular above; outer ramelli articulate, articulations distinct, alternately long and short, the longer ones corticate, polysiphonous; shorter ones form a node (or nob); the secondary ramelli sparsely hirsute, with the cortical cells at the nodes arranged in an almost single row; the apices acuminate and simple, the articulations of the ramuli shorter than wide, of the ramelli a little longer.

South Australia (Investigator Strait, Eastern Bays), Tasmania.

Spyridia breviarticulata J. Agardh.

Fronds filiform, vaguely branching on all sides, branches developing an irregular cortex, upper part of the ramuli and smaller ones externally articulate; articulations distinct, shortly corticated, polysiphonous and nodes almost equally long; ramelli pile-like, sparse, at the nodes the cellular cortex forming a conspicuous slight band; terminal simply acuminate; articulations of branches shorter than their diameter, of the ramelli longer.

South Australia (Encounter Bay, Investigator Strait, Eastern Bays), Friendly Islands.

Spyridia opposita Harvey.

Attachment a callous disc, frond 20 cm. to 35 cm. long, obtusely angular, subdistichous, the ramuli widely spreading, then straight; the ramelli corticate to the apices, slightly irregular, the pinnae long, robust, attenuated, opposite, patent, incurved, converging towards the apices, corticate at the nodes with a wide band of cortical cells, acuminate and simple at the apices. Colour red, substance rigid, adheres imperfectly to paper.

South Australia (Gulf St. Vincent, Encounter Bay, Eastern Bays), West Australia, Tasmania.

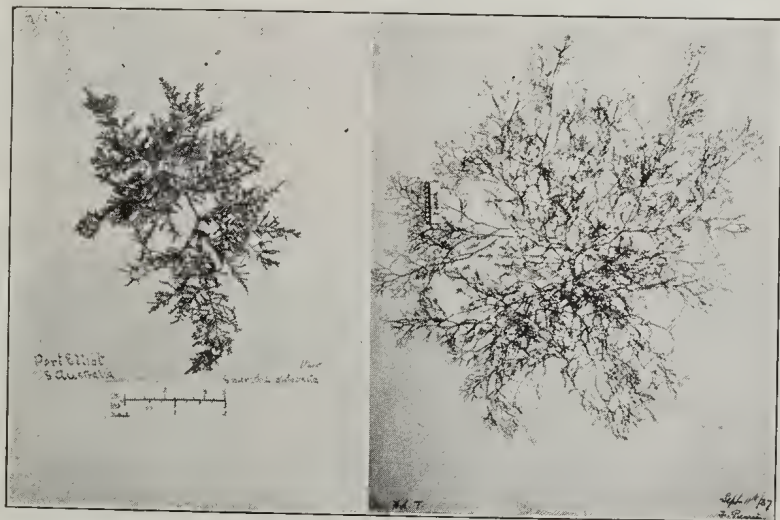


Fig. 182.—*Spyridia opposita*.

Fig. 183.—*Ceramium nobile*.

Spyridia nobilis J. Agardh.

Frond wide, caulescent, ramuli pyramidal, irregular, verticillate; stem robust, subspongiose, sometimes with decurrent fibres from the upper surface of the frond, and sometimes apparently spongiose, covered with an outer fibrous covering; ramuli elongate, conspicuously articulate, covered with pinnae; the ramelli end at times in terminal fascicles; pinnae sometimes verticillate around the nodes, the pinnae articulate, mucronate, simple. Cystocarps globose, surrounded by a whorl of incurved pinnae.

South Coast of Australia.

Spyridia Wilsonis J. Agardh.

Frond compressed, irregularly pinnate at the margin, pinnellae sub-lanceolate above the pedicel, conspicuously attenuated, sublinear, apices acuminate, the whole thickly corticate, sparsely branched; the ramelli elongate, filiform, simply acuminate; articulations more than twice as long as wide.

South Coast of Australia.

Spyridia squalida J. Agardh.

Frond terete, very caulescent, below apparently widely branched, the ramuli above subdistichous, pinnate, the ramelli attenuated, clavate-fusiform, corticate to the apices, incurved and with inner lateral pinnae; rachis sub-bifariously branched, the pinnae robust, obtuse, corticate, with few cortical cells at the node; articulations of the pinnae shorter than wide; from the cortical cells at the nodes the tetraspores are formed, mostly in rows on the inner side, sometimes opposite.

South Australia (Encounter Bay, Eastern Bays), South Africa.

Spyridia dasyoides Sonder.

Frond 20 cm. to 25 cm. long, primary frond subcorneous, solid, depressed-quadrilateral, distichously branched, with finer ramelli monosiphonous, articulate, pinnulated, the pinnae densely hirsute, rigid, slightly incurved, acute, articulate; articulations as long as wide, nodes purplish; ramuli 10 cm. to 12 cm. long, ramelli 5 cm. to 12 cm. long. Cystocarps obtuse, three lobed, pedicellate, carried laterally in the ramelli. Colour purplish.

South Australia (Holdfast Bay).

BRACEBRIDGEA J. Agardh.

Frond cylindrical, widely and irregularly branched, the lower ramuli conspicuously attenuated, the primary ones regular; near the axis the siphons are cylindrical, oblong, placed one above the other forming one central row; an intermediate layer covers the central siphons very densely; the confervoid filaments have long articulations, spread longitudinally and together with the united central siphons, are covered with a lime-like substance; outer filaments verticillate, with short articulations, sparsely dichotomous, regular; the ramuli of the filaments free, alternate, the inner articulations of the filaments cylindrical; the terminal ones are obovate.

Bracebridgea australis J. Agardh.

The only species, with the characters of the genus.

South Australia (Encounter Bay).

HALIACANTHA J. Agardh.

Frond terete, irregularly branched, the young ramuli articulate and monosiphonous, very soon becoming caulescent, covered more or less thickly with articulate, decurrent filaments uniting into an outer tube; the terminal ones penicillate, very soft, and the lower ramelli rigid, divaricate and finally anastomosing; the fertile part apparently glabrous. Cystocarps laterally rising from the transformed glabrous ramelli, the terminal fascicles covered with pyriform carpospores, prominent and scattered everywhere; the encasing ramelli soft, elongate, involucrate. Tetrasporangia carried on the monosiphonous ramelli, externally, mostly singly, triangularly divided.

Haliacantha incrustans J. Agardh.

The only species, with the characters of the genus. It has the habit and size of a *Spyridia*.

Southern Australia.

Subfamily Ceramieae (Dumort) Schmitz.

CERAMIUM Wiggers.

Frond erect, filiform, dichotomous or pinnately branched, articulate, monosiphonous, with a definite layer of cells at the nodes, or the interstices corticate with the cells at the nodes placed irregularly. Cystocarps sessile on the ramelli, which are involucrate, carrying many angular carpospores in a hyaline sack. Tetrasporangia formed from the changed cortical cells, prominent, more or less outside the cortex, spherical, triangularly divided. Antheridia on the surface of the ramelli formed of minute hyaline cells.

Ceramium macilentum J. Agardh.

Frond dwarf, scarcely 5 cm. long, filaments very slender, irregularly patently branched, caespitose; articulations of the ramuli short at the apices, slightly longer in the glabrous zone, the lower ones very long; the nodes are very narrow, consisting of a few rotund cells, glabrous, succulent. Tetrasporangia subsecund on the outer side of the ramelli, formed within the groups of lateral cells, and above on the glabrous part, prominent and almost solitary.

Victoria (Port Phillip).

Ceramium repens Harvey.

Frond dwarf, primary filaments prostrate, creeping from the attachment; ramelli erect and free; secondary ramelli simple, articulations almost three times as long as wide; interstices glabrous. Tetrasporangia singly at the nodes, unilateral, prominent.

Victoria (Port Phillip).

Ceramium ramulosum Hooker f. and Harvey.

Frond filiform, dichotomous, patently subbranched at almost every node; the terminal segments acute, lower articulations longer than wide, interstices somewhat coloured and glabrous. Tetrasporangia secund on the

outer side of the ramelli. Cystocarps subterminal towards the apices, set in an involucre of ramelli.

Tasmania (in the Tamar).

Ceramium fastigiatum Harvey.

Frond 10 cm. to 20 cm. high, filiform, regular, irregularly dichotomous, fastigate; the segments erect, patent, apices furcate, lower articulations longer than wide, upper interstices somewhat coloured. Tetrasporangia verticillate around the nodes, sometimes few outside the cortex, almost always glabrous. Cystocarps sessile on the segments, lateral; involucre ramelli round the cystocarps slightly prominent, simple, sparse; the colour of the caespitose parts purplish, the ends bright red. Substance flaccid; does not adhere to paper.

West Australia (Fremantle), Atlantic, and Mediterranean.

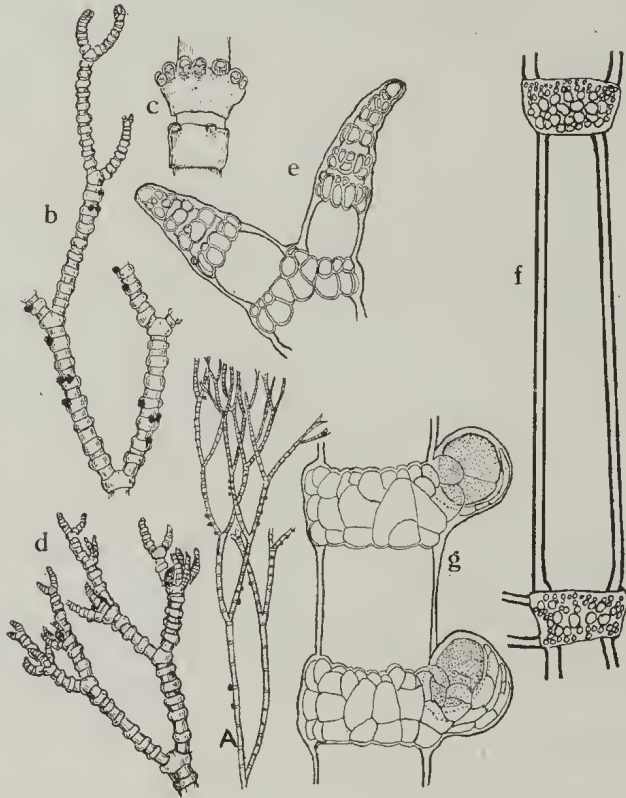


Fig. 184.—*Ceramium fastigiatum*: a, upper forks of a tetrasporic plant, showing form of apices, distribution of tetrasporangia in young nodes, and relative nodal development, x 50; b, nodes from an older part, showing several emergent tetrasporangia, x 50; c, detail of upper branching of a small portion of a tetrasporangial plant, x 6; d, uppermost forkings, showing young cystocarps with involucre branchlets, x 25; e, forked tip of the type with divergent apices, x 150; f, two nodes with cortication, from an old portion of the axis; g, type with incurved apices, node from a matured branch showing emergent tetrasporangia with slight upgrowth of cells from below. (After Taylor.)

Ceramium puberulum Sonder.

Frond 15 cm. to 30 cm. or longer, setaceous, alternately branched; lateral ramuli short, the ramelli dichotomous, the terminal ones irregularly forcipated, especially on the outer edge, with a row of articulate bristles; articulations about three times longer than wide below, upper interstices bare. Tetraspores carried singly on the bristly swellings on the outer side of the segments. Cystocarps in an involucre of ramelli.

South Australia (Holdfast Bay, Gulf St. Vincent, Eastern Bays), West Australia, Tasmania.

Ceramium miniatum Suhr.

A primary creeping filament throws up minute, scattered, erect fronds; fronds compressed, distichously subbipinnate; pinnae dichotomous, the terminal segments very short, tooth-like; articulations shorter than their diameter. Primary filaments prostrate on the surface of other algae, creeping by means of small discs, and throwing up scattered erect fronds. Fronds about 1 cm. to 2 cm. long, oblong with flexuous rachides. Pinnae alternate, more or less compound. Articulations coated with cellules round the joints, pellucid in the middle, joints of the ramuli very short, with narrow band. Apices slightly hooked inwards. Cystocarps in pairs, oval, subterminal, subtended by three or four short ramuli. Tetrasporangia very prominent, globose, arranged along opposite margins of the ramuli in longitudinal rows. Colour bright purple; adheres to paper.

West Australia (Swan River), New South Wales (Kiama), Peru.

Ceramium pusillum Harvey.

Frond short, about 6 cm. to 8 cm. long, irregularly pinnate, ramuli subdistichous, corymbose-fastigate, the pinnellae alternate and patent, terminal segments upright and acute; the articulations are equal or shorter in length than they are wide, entirely corticate. Tetrasporangia immersed in the cortex, verticillate, many around the nodes, elsewhere sparse. Cystocarps in a slightly prominent involucre of ramelli.

West Australia, Victoria (Port Fairy, Warrnambool).

Ceramium subcartilagineum J. Agardh.

= *Ceramium rubrum australe* Harvey.

Frond setaceous, dichotomous, subfastigate, ramelli lateral, virgate; secondary ramelli elongate, conspicuously thicker at the base, acuminate for a long distance; the nodes placed one above another in a long row, very soon confluent in the adult ramelli; lower articulations about one and a half times longer than wide. Tetrasporangia immersed subverticillately in the soft nodes of the penultimate ramelli. Substance gelatinous when fresh, when dry subcartilaginous; young plants red, old plants almost pink-grey.

South Australia (Encounter Bay), Tasmania.

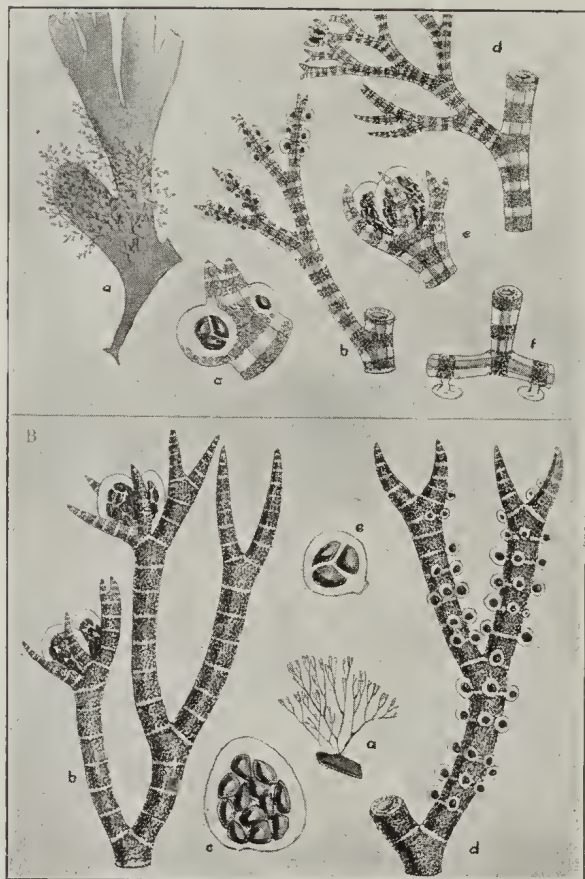


Fig. 185 (upper).—*Ceramium miniatum*: a, plant, growing on a young frond of *Dictyota Kunthii*; b, pinna, with tetraspores; c, apex of one of the divisions of the same; d, pinna, with favellae; e, apex of a division, with its terminal involucre containing favellae; f, part of a creeping primary filament. (After Harvey.)

Fig. 186 (lower).—*Ceramium isogonum*: a, plant; b, branchlets, with favellae; c, a favella; d, branchlets, with tetraspores; e, a tetraspore. (After Harvey.)

Ceramium isogonum Harvey.

Attachment a small disc. Frond 2 cm. to 5 cm. high, distantly dichotomous, fastigiata, flabelliform, with strongly hooked apices. Articulations of nearly equal length and breadth in all parts of the frond, equally coated with coloured granules, except on a narrow medial, pellucid line. Cystocarps ovoid, in pairs near the ends of the branchlets, each pair subtended by two or three short ramuli. Tetrasporangia very prominent, globose, whorled round the articulations at or near the medial pellucid line. Colour deep purple-red.

West Australia (Garden Island), Victoria (Port Fairy), Tasmania.

Ceramium nodiferum J. Agardh.

Frond setaceous below, dichotomous, attenuated above; ramuli lateral, subfasciculate, erect; ramelli very soft, terminal ones erect; lower articulations twice as long as wide; interstices pellucid, the penultimate ramuli and the lateral ramelli bearing tetraspores, attenuated, lanceolate; tetraspores verticillate within the articulations causing a swelling, immersed in the cortex, translucent.

Victoria (Port Phillip), New Zealand.

Ceramium nobile J. Agardh.

Frond 15 cm. to 24 cm. long, setaceous, broad, dichotomous, shorter branches irregularly alternate; fertile ramelli conspicuously transformed almost into stichidia, secund and sub lanceolate; articulations of the stichidia moniliformly torulose. Tetrasporangia numerous, verticillate, immersed, finally issuing vertically from the articulations. Sterile upper articulations as long as wide, lower ones almost twice as long as wide. Colour purplish-red when wet.

South Australia (Encounter Bay, Eastern Bays), Tasmania.

Ceramium gracillimum Griff. and Harvey.

Frond 2 cm. to 15 cm. long, densely caespitose, very slender and flaccid, dichotomous, the ramelli somewhat dissimilar, lateral, fastigiata, forcipate; lower articulations longer than wide. Tetrasporangia subverticillate, their upper parts emerging glabrous, surrounded below by cortical cells. Cystocarps subterminal at the apices of the ramelli; the ramelli of the involucre elongate, forcipate, many patent and umbellate. Colour violet-purple. Adheres to paper.

South Australia (Eastern Bays), Tasmania, Europe, West Indies.

Ceramium excellens J. Agardh.

Frond setaceous, elongate, dichotomous, the shorter ramelli rising from the nodes, the upper ones secund on the outer side of the ramuli; the lower ones opposite, or often verticillate; the lower articulations up to three times as long as wide, contracted at the nodes; interstices pellucid, narrow at the transverse line, lateral ramelli bearing tetraspores, sub lanceolate, torulose. Tetrasporangia verticillate, immersed within the articulations, causing a swelling.

Victoria (Port Phillip), Tasmania.

Ceramium clavulatum Agardh.

= *Centroceras clavulatum* Montagne.

Frond 10 cm. to 17 cm. long, filiform, spinose, regularly dichotomous, fastigate, proliferous from the axils; terminal segments incurved and forcipate, the lower articulations longer than wide, the spinules of the nodes verticillate. Tetrasporangia verticillate round the nodes. Cystocarps in pairs, the ramelli of the involucre four to five, rising above the fruit.

West, South, and East Australia.

Ceramium cinnabarinum (Gratel.) Hauck.

= *Centroceras cinnabarinum* J. Agardh.

Frond 5 cm. to 12 cm. long, filiform, not spinose, dichotomous, fastigate, sparsely proliferous, terminal segments subforcipate, erect, lanceolate, conspicuously attenuated; the zones of the nodes protracted into minute apices at the upper edge; cortical cells arranged longitudinally, alternately transverse, almost wider than long. Tetrasporangia almost immersed, prominent. Colour purplish; adheres to paper.

South Coast of Australia, New Zealand, Cosmopolitan.

The following genus is placed in the *Ceramiales* by De Toni, but is of uncertain position.

THAMNOCARPUS Harvey.

Frond filiform, branched, articulated, monosiphonous, the stem and branches (in many species) at length thickened internally or coated externally with decurrent filaments; ramuli always pellucidly articulate and monosiphonous. Cystocarps generally in pairs, axillary or sessile on the branches, naked, containing numerous angular spores. Tetrasporangia naked, sessile or pedicellate on the ramuli.

Thamnocarpus Gunnianus Harvey.

Frond 15 cm. to 25 cm. long, bushy, cartilaginous-corneous, terete, widely branched, the upper ramuli very dense, subfastigate, obtuse; on the fertile ramuli sparse fascicles of filaments are arranged at the apices; articulations of the filaments about twice as long as wide.

South Australia, West Australia, Tasmania.

Thamnocarpus penicillatus (Harv.) J. Agardh.

= *Callithamnion penicillatum* Harvey.

Tree-like; stem and branches thickly corticated throughout, decomponently branched, ultra-setaceous; branches nearly naked, or thinly beset with minute, byssoid, pencil-like articulated ramuli; ramuli clothed with very slender, many times forked ramelli.

Attachment or holdfast a minute disc. Frond 5 cm. to 8 cm. high, about 1 mm. thick at the base, gradually tapering upwards, irregularly branched, inarticulate, opaque, thickly coated with cortical cellules. Branches virgate, alternate, acute, older ones nearly naked, younger ones emitting minute ramuli. Ramuli 2 mm. long, slender, articulate, clothed with minute soft, forked ramelli. Colour of stem dark-red, of the ramuli rosy.

Victoria (Port Phillip—on *Maerocystis*).



Fig. 187.—*Thamnocarpus penicillatus*: a, plant, growing on a vesicle of *Macrocystis*; b, frustule of a branch, bearing one of the byssoid pencilled ramuli; c, a ramellus from the same; d, transverse section of a branch; e, longitudinal section of same. (After Harvey.)

Thamnocarpus (?) *glomeruliferus* J. Agardh.

Frond filiform, up to 30 cm. long, elongate, upper branches elongate and virgate, ramuli separated by glomerulate ramelli as if knotted, the stem and ramuli conspicuously articulated, densely corticate; articulations one and a half times as long as wide, separated by a vague line of nodes; ramelli issuing from the nodes, articulate and very much branched, young ones soft, the adult ramelli rigid, with rows of spinules on the apices and upper nodes. Colour red.

South Australia (Eastern Bays), West Australia (Champion Bay), Victoria (Port Phillip).

Order **CRYPTONEMINAE** Schmitz.

CONSPECTUS OF THE FAMILIES.

I.—Auxiliary cells arising from true articulated filaments which have arisen by secondary development. Gonimoblasts (fertile nucleus) immersed in the fronds.

Grateloupiaceae. Procarp, filaments of carpogonial cells and of auxiliary cells disposed in erect flask-shaped structures. Gonimoblasts divided into many lobes which arise by successive development. Nearly all cells transformed into carpospores.

Dumontiaceae. Filaments of auxiliary cells arcuate; numerous filaments intermixed with slightly arcuate carpogonial cells. Gonimoblasts imperfect, divided into lobes arising successively. Nearly all cells forming carpospores.

II.—Auxiliary cells are carpogonia evolved in true corticated segments of the frond.

A.—Fertile segments of fronds thick and nematheciose. Auxiliary cells numerous, enclosed in articulated filaments. Gonimoblasts congested in sori.

Rhizophyllidaceae. Carpogonia situated in articulated filaments of the frond and many abbreviated to terminal cells. Gonimoblasts divided into many lobes. Cells nearly all forming carpospores. Fronds terete or ancipitous-plane, sometimes encrusted with lime.

Squamariaceae. Filaments of carpogonial cells abbreviated or lateral. Gonimoblasts minute, articulated filaments short, simple or branched. Nearly all cells forming carpospores. Fronds dorsi-ventral.

B.—Numerous auxiliary cells situated around the articulated filaments of the carpogonial cells or evolved distinctly in articulated filaments of the frond, with the carpospores congested in sori.

Corallinaceae. Auxiliary cells, after fertilization, all uniting in turn. Many gonimoblasts formed from the fusion cell (forming short chains of carpospores). Fronds nearly always encrusted with lime.

Family **GRATELOUPIACEAE** Schmitz.

KEY TO THE GENERA.

a. Sporangia nidulating in the exterior region of the cortex.

b. Fronds terete, angular-complanate or foliaceous.

Branching variously furcate or lateral, not proliferous. Internal stratum filamentous-reticulate

Halymenia (Ag.)

J. Agardh.

bb. Fronds compressed-plane or foliaceous.

- e. Fronds furcate or laterally branched. Sporangia superficial, sparse. Filaments of medullary reticulum conjoined. Internal cortex lax, external firm, cells in anticlinal order

Grateloupia

Agardh.

- ee. Fronds entire or irregularly lobed. Sporangia superficial, sparse. Internal cortex lax, external thick, cells in anticlinal order ..

Pachymenia

J. Agardh.

De Toni places the genus *Epiphloca* J. Ag. after *Pachymenia*.

aa. Sporangia evolved in nemathecium.

- d. External cortex of minute cellules, in anticlinal order.

- e. Fronds not net-like or perforated.

- f. Fronds linear, complanate, furcate or pinnate. Medullary stratum firmly filamentous. Internal cortex lax, external dense

Prionitis

J. Agardh.

- ff. Fronds complanate, repeatedly furcate, here and there slightly constricted. Medullary stratum dense, filaments anastomosing. Cortex dense

Polyopes

J. Agardh.

- ee. Fronds reticulately perforated, more or less complanate, branched

Codiophyllum

Gray.

dd. Cortex of parenchymatous structure.

- g. Fronds below caulescent, simple, furcate or digitately laciniate, lacinae with a medium evanescent costa. Medullary filaments firm, laxly disposed. Cortex dense

Cryptonemia

J. Agardh.

- gg. Fronds furcate or laterally branched, margin and disc with prominent numerous horn-like processes, below with a median costa. Medullary filaments firm. Cortex dense ..

Thamnoclonium

Kützinger.

Genus of doubtful position.

Blastophye J. Agardh. Fronds carnosoplane, lacinae round, definite, from the margin or within proliferous, of three strata.

Family GRATELOUPIACEAE Schmitz.

HALYMENIA J. Agardh.

Fronde terete, compressed or flat, gelatinoso-membranous, dichotomous or pinnatifid, composed of two strata; the medullary stratum formed of a few, laxly interlaced, branching filaments, lying in a gelatinous matrix; the cortical membranous, formed of minute, coloured cells. Cystocarps immersed in the frond. Tetraspores scattered through the surface-cells.

Halymenia Harveyana J. Agardh.

= *Halymenia Floresia* Agardh.

Fronde softly membranous and slippery, flat, stipitate, elongate, pinnately decompose; the pinnae and pinnules broadly linear, acuminate, spreading, either entire or serrato-lacerate and ciliate.

Attachment a minute disc. Frond rising with a slender, compressed, linear stipe, that soon becomes cuneiform and gradually passes into the base of a broadly linear principal lamina 15 cm. to 50 cm. long and 1 mm.

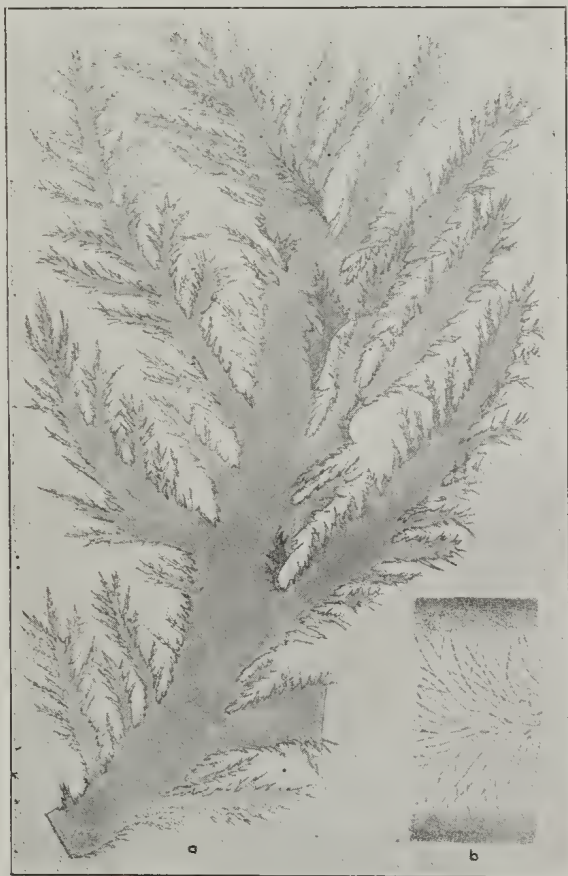


Fig. 188.—*Halymenia Harveyana*: a, plant; b, section of the frond. (After Harvey.)

to 3 mm. wide. This principal lamina is simple or forked and set throughout with lateral branches or pinnae, which are furnished with a second or third series of lesser divisions. Form and size vary very much. Margins in some specimens entire, in others slightly toothed, in others deeply cut; either flat, undulate or curled. Apices of all branches very acute. Colour bright pink-red. Substance gelatinous. Distributed in many parts of the world.

South Australia (Eastern Bays), Western Australia, Victoria.

Halymenia plana Zanardini.

Frond foliaceous, thinly membranous, incisely lobate, the lobes broad and obovate, the margin entire; the structure dense and compact.

Victoria (Port Phillip).

Halymenia (?) *Muelleri* Sonder.

= *Nemastoma* (?) *gelinarioides* Harvey.

Frond 10-15 cm. wide, compressed, irregularly pinnate, rachis broad; pinnae attenuated, dentate at the margin, denticulations very patent, horizontal, not as wide as the rachis.

South Australia (Lefevre Peninsula).

Halymenia digitata J. Agardh.

Frond caespitose, globose, 12 cm. to 20 cm. across, thick, irregularly dichotomous, compressed, the segments above the cuneiform base expanded in a linear fashion, subpalmate, flabelliform; the adult ramuli bear proliferous segments from the margin, above the narrower stipe, cuneiform, dilate, subpalmate, multifid. Colour purplish-red. Adheres to paper.

Victoria (Port Phillip).

GRATELOUPIA Agardh.

Frond compressed, gelatinous, membranous, sometimes almost tubular, dichotomous, pinnate or proliferous; cortex consisting of two layers, the inner of articulate filaments, net-like, sometimes very anastomosed, often loosely so; the outer filaments moniliform, loosely or solidly united with mucus. Cystocarps minute, scattered over the frond or irregularly collected in sori, in depressions below the cortex, with filaments issuing from the cavities, nucleus simple, surrounded by a hyaline membrane. Tetrasporangia immersed in the cortical layer, sparse, cruciate. Colour reddish-brown.

Grateloupia prolifera J. Agardh.

Frond up to 60 cm. high, compressed, linear, elongate, very attenuated, regularly proliferous from the margin, irregularly proliferous from the pinnae, finally glabrous at the apices. Cystocarps numerous over the whole frond. Tetrasporangia developed on the young ramelli.

Tasmania.

Grateloupia gigartinoïdes Sonder.

Frond membranous, at the base terete, above compressed, alternately bipinnate; pinnae regular, distichous, patent, elongate, sub lanceolate,

acuminate, subfalcate, angular at the base. Tetrasporangia in dense groups of scattered fertile sori. Substance firm. Colour purple below, paler above.

Victoria (Port Phillip).

Grateloupia filicina (Wulf.) C. Agardh.

Frond to 25 cm. long, compressed-plane, irregularly pinnate and proliferous from the disc; pinnae at base narrow, linear, acuminate; below longer and pinnulate, above simple. Cystocarps immersed in the pinnae. Tetraspores immersed in the pinnules, often grouped together. Colour purple or violet. Substance membranaceous.

East Coast of Australia and Tasmania, Atlantic and Mediterranean Oceans.

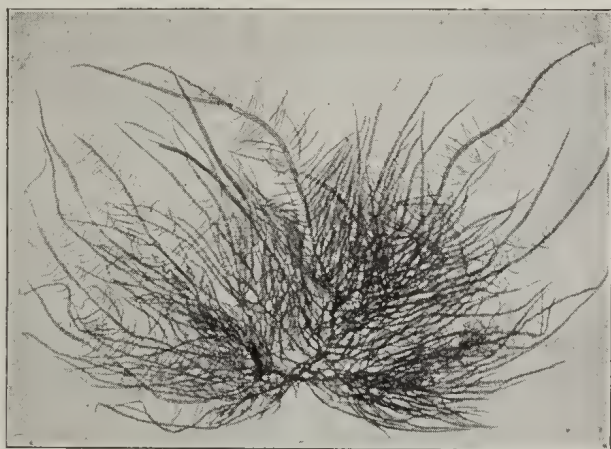


Fig. 189.—*Grateloupia filicina*.

PACHYMENIA J. Agardh.

Frond flat, foliaceous, very thick, entire or widely lacinate, or fairly regularly dichotomous; composed of articulate filaments, the inner ones elongate, sparsely branched, very dense, intertwined, denser in the centre; the intermediate ones a little looser, shorter, anastomosing; the cortical filaments vertical and fasciculate, very long, solidly united with mucus. Cystocarps scattered over the frond, minute, often in many rows in depressions of the cortical layer, with filaments issuing from the cavities. Tetrasporangia immersed in the cortical layer, sparse, elongate, cruciate.

Pachymenia apoda J. Agardh.

Frond 4 cm. to 9 cm. long, sessile or shortly stipitate, obovate-rotund, with one lobe or a second rising from just within the margin, or sometimes lobate, with secondary lobes, contracted below into short stipes, the adult ones fairly widely laciniate, more or less regular. Tetrasporangia oblong, cruciate.

South Coast of Australia, Tasmania.

Pachymenia prostrata J. Agardh.

Frond parchment-like, thick, radiating widely from the centre, prostrate, rising at the outer side fairly freely; attachment composed of many fasciculate filaments. Young ramuli elongate, cylindrical, acuminate, simple or slightly branched, apices free; adult ramuli with the apices united into an expanded shield shape; the lower ones extending beyond the attachment.

South Coast of Australia.

Pachymenia stipitata J. Agardh.

Frond to 30 cm. long, elongate, obovate-cuneate, with numerous ramuli rising from the attachment, subfasciculate; stipes elongate and compressed, almost terete at the base, very attenuated. Colour dark purplish, almost shining. Substance, when dry, membranous, corneous, and elastic.

South Australia (Gulf St. Vincent, Encounter Bay, Investigator Strait).



Fig. 190.—*Pachymenia prostrata*.

EPIPHLOEA J. Agardh.

Frond flat, thickish, entire or torn, formed of two strata; the medullary of sparingly branched, densely interwoven, jointed threads; the cortical of moniliform threads, vertical to the surface, and set in a firm gelatinous matrix. Cystocarps immersed in the substance of the frond, simple, containing within a gelatinous envelope a mass of rounded spores. Tetrasporangia cruciate, dispersed through the outer stratum of the frond.

Epiphloea grandifolia J. Agardh.

Frond shortly stipitate above, cuneate, very soon dilated, with very strong folia; the folia elongate, oblong, up to 30 cm. long, at the margin sparsely dentate or undulate, thick, firm and almost undivided, the whole surface fertile. Tetrasporangia cruciate, oblong, subsingle. Colour intense reddish-purple.

Victoria (Port Phillip).

PRIONITIS J. Agardh.

Frond compressed, linear, dichotomous or subpinnate sometimes glandulose or proliferous from the disc or margin; cortex consisting of three layers the inner one formed of very dense filiform cells, the middle one of rotund cells, the outer one of smaller vertically radiating cells. Cystocarps immersed in the frond in depressions in the cortex, with filaments issuing from the cavities of the cystocarps, nucleus simple. Tetrasporangia carried on the marginal phyllodia or glands, immersed, sparse, oblong, cruciate.

Prionitis microcarpa (Ag.) J. Agardh.

Frond 6 cm. to 7 cm. long, terete below, compressed above, thick, narrow, linear, irregularly dichotomous, flabellate, fastigate; segments patent, margin bare, apices regular and obtuse. Cystocarps in the upper segments. Substance scarcely cartilaginous, flexible. Adheres to paper. Colour purplish.

South Australia (Encounter Bay). •

POLYOPES J. Agardh.

Frond compressed, almost terete, dichotomous, fastigate, consisting of two layers, the inner one having filaments branched and anastomosing, the outer one having filaments vertical, moniliform, and solidly united with mucous. Cystocarps grouped in certain parts, often in many rows in depressions in the cortex, with filaments issuing from the cavities, nucleus simple. Tetrasporangia subnemathecious, developed densely among the sparse cortical filaments, oblong, cruciate.

Polyopes constrictus (Turn.) J. Agardh.

Frond 8 cm. to 15 cm. long, expanded from the attachment, compressed, linear, repeatedly dichotomous, flabellate, fastigate, here and there constricted, slightly irregular; upper segments constricted, almost separate, carrying immersed cystocarps. Colour purplish. Substance firm, fleshy. The nemathecium of the tetraspores cause spotted lines, surrounded by a sterile margin, rotund at the apices.

South Australia (Encounter Bay), South Africa.

CODIOPHYLLUM Gray.

Frond more or less flattened, branched, lower ramuli foliaceous, elongate, upper ramuli subulate at the apices or incised-reniform and regular. Lower parts of the foliaceous ramuli costate, with finer costae reticulated. Cystocarps and tetraspores developed on the folia.

Codiophyllum marchesettiioides (J. Ag.) Schmitz.

Frond up to 20 cm. long, erect, ramuli above the base thick, very soon becoming spongiöse and terete, compressed above, unevenly contracted and dilated; parts of the different ramuli grow close together and unite forming a very dense network of filiform ramelli, the interstices of the network very small, the translucent spaces not visible to the eye. Fertile phyllodia developed sparsely on the sides of the frond, singly or in clusters.

West Australia (King George Sound).

Codiophyllum squamarioides (J. Ag.) De Toni.

Frond about 15 cm. long, prostrate, later erect, flabelliform, the upper part rugose and proliferous with new fronds, the lower part eostate, with finer costae flabellate, slightly more prominent; the various flabelli grow together at the apices, forming a very dense network of filiform ramelli; interstices of the network very small, the translucent spaces not visible to the eye. Fertile phyllodia developed on the costae of the lower part of the frond, often numerous and subdistichous.

West Australia (King George Sound).

CRYPTONEMIA J. Agardh.

Frond flat, rigid, caulescent, proliferous and branched, formed of three strata; the medullary stratum of longitudinal, slender, closely interwoven filaments; the intermediate of roundish cells; the cortical of minute cellules. Cystocarps immersed in the substance of the frond. Tetrasporangia eruciate, collected in roundish sori, either under the apices or in special fruit leaves.

Cryptonemia undulata Sonder.

Caulescent, stem dichotomous, winged above, and passing into basally midribbed, broadly linear, forked, eurled and bluntly lobulate laminae; axils very open, apices blunt.

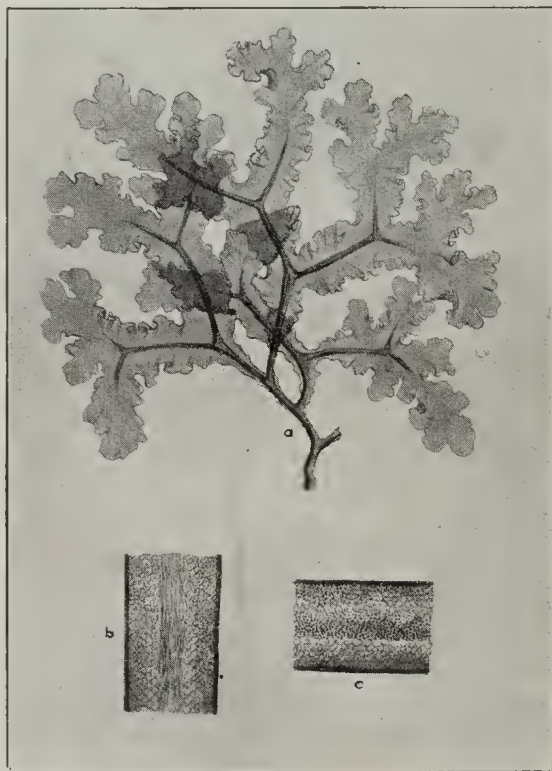


Fig. 191.—*Cryptonemia undulata*: a, plant; b, longitudinal section of the lamina; c, cross-section. (After Harvey.)

Attachment discoid. Frond tufted, 8 cm. to 12 cm. long and as much in the expansion. Stem filiform, very rigid, winged, forked, each division passing into the midrib of a terminal forked lamina, the midrib disappearing long below the apex. Laminae 1 cm. to 2 cm. wide, with curled, undulating margin. Forking of the stem very wide; all apices very blunt. Colour pinkish-red. Substance when fresh, like parchment; when dry, very tough and rigid. Does not adhere to paper.

South Australia (Encounter Bay, Gulf St. Vincent, Eastern Bays), West Australia (King George Sound), North-East Australia.

THAMNOCLONIUM Kützing.

Frond dendroid or flabelliform, compressed or plane, imperfectly costate, rigidly horny, mostly covered with spinous tubercles, composed of two strata; the medullary stratum very dense, of slender, cylindrical, longitudinally seriated cellules; cortical of roundish-angular, coloured cells. Tetrasporangia cruciate, contained in a sporophyll.

Thamnoclonium claviferum J. Agardh.

= *Thamnoclonium hirsutum* Harvey.

Frond decompound-dichotomous, fastigate; branches terete, smaller ones subcompressed, closely covered with muricated warts, obtuse; spore leaves in rose-like tufts, lateral or terminal, containing beneath their surface tetrasporangia.

Attachment a broad rigid disc. Fronds several from the same base, 15 cm. to 25 cm. high, simple for 5 cm. to 8 cm. above the base, then forking and afterwards many times forked. Branches nearly level, patent, with acute axils; the larger ones terete, the upper wider and compressed. All parts except denuded stem closely covered with oval, multifid-foliated warts, fixed to the branch by a slender neck. Tetrasporangia borne in the periphtric cells of little roundish wavy spore-leaves, which occur in tufts at the end or any part of the sides of the branches. The cellular structure of the frond is very dense, composed of minute cellules. Colour dark, dull brown-red. Substance extremely rigid and tough.

South Australia (Gulf St. Vincent, Encounter Bay, Investigator Strait, Eastern Bays), Tasmania.

Thamnoclonium codioides J. Agardh.

Frond subterete, densely branched, the ramuli close together at the apices; younger ones clavate, subdilate, the angular rachis verrucose and crispate, leaving bare sinuous interstices; fully grown ramuli denuded at the base; fertile phyllodia rotund-reniform, crispate, forming lateral rose-like tufts, rarely subterminal. Colour very dark-red.

South Australia (St. Vincent Gulf).

Thamnoclonium proliferum Sonder.

From 25 cm. or longer, flattened, flabellate, finally subdichotomous; younger ramuli cuneate-linear, clearly ancipitous, irregularly verrucose; single tubercles irregularly prominent, covering the surface and margins

very densely; the fully developed ramuli almost wholly covered at the base and plane phyllodia bearing cystocarps rising densely from the plane surface; those bearing tetrasporangia terminal; subsessile, pinnately lacinate.

South Australia (Gulf St. Vincent), West Australia.

Thamnoclonium Lemnarianum Harvey.

Frond dendroid, the stem cylindrical, branches winged below, expanding upwards into flat, strongly midribbed phyllodia, at length proliferously

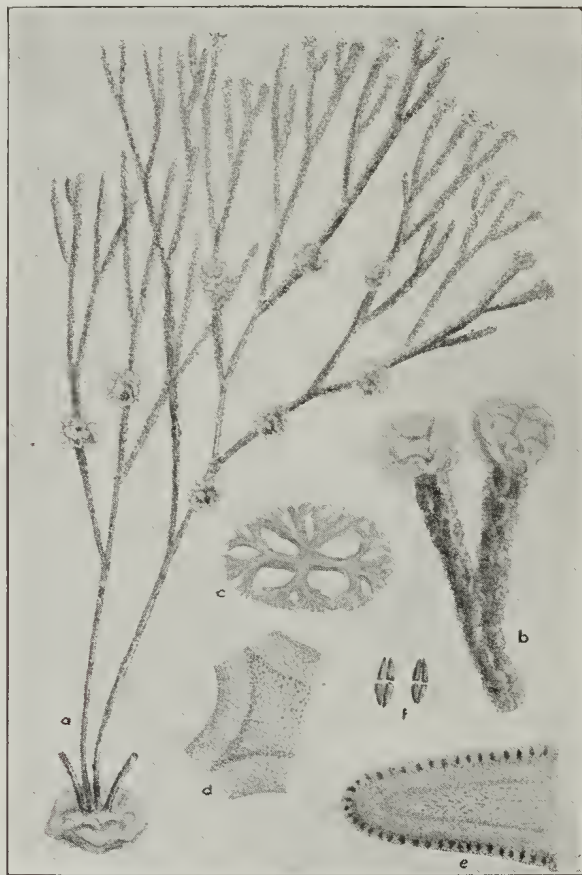


Fig. 192.—*Thamnoclonium clariferum*: a, plant; b, apex of branch, with two terminal spore-leaf clusters; c, section through a ramulus; d, cellular tissue of same; e, section through a spore-leaf; f, tetraspores. (After Harvey.)

much branched; phyllodia linear-euniform, sinuoso-pinnatifid, covered with muricated warts and traversed by a vanishing, immersed midrib; apices and laciniae very obtuse.

Attachment a disc, 4 mm. to 9 mm. thick, with a few short clasping branches. Stem cylindrical, very hard and woody, branched; the branches dividing irregularly, soon becoming winged at the edges and passing upwards into the strongly ribbed phyllodia. Phyllodia 8 cm. to 15 cm.

long, linear-oblong, obtuse, tapering at the base, margin sinuate or incised in an alternately pinnatifid manner; lobes few, erect, linear-oblong, with an immersed midrib, becoming faint towards the apices. The surface is thickly covered with minute echinated warts, giving it a rough feel; warts both large and small. Colour dark brown-red. Substance hard and rigid. Does not adhere to paper.

West Australia (Fremantle).

Thamnoclonium dichotomum J. Agardh.

Fronds complanate, flabellately expanded, at length subdichotomous; young branches cuneate-spathulate, obtuse, at length with bifid or trifid apices from the ancipitous plane frond; verrucose, forming immediately short, truncate, equal strata of cells on the plane face, leaving minute, naked, interstitial spaces; older branches at length denuded at base, subterete.

South Australia (Gulf St. Vincent).

BLASTOPHYE J. Agardh.

Frond lacinate, proliferous from the margin or from within the margin, formed of three layers; the inner of filaments, articulate and densely interwoven; the middle layer of rotund-angular cells; the outer of rotund, vertical cells, almost in rows. Cystocarps immersed in the frond, the nucleus strong and apparently simple. Carpospores are numerous, minute, and grouped irregularly.

Blastophye Wilsoni J. Agardh.

= *Cryptonemia Wilsoni* J. Agardh.

Frond 2 cm. wide, 6 cm. to 10 cm. long, cuneate above the stipe, lanceolate, linear, di-trichotomous, more or less irregular; more often the phyllodia rise from the entire margin, sometimes pinnate or palmate; the proliferous young phyllodia obovate-ligulate, the fully developed ones lanceolate and linear. Cystocarps sparse, irregularly spread over the adult frond. Substance very membranous. Colour bright red.

South Coast of Australia.

Family DUMONTIACEAE (Bory) Schmitz.

DASYPHLOEA Montagne.

Frond cylindrical, dendroid, membranaceo-cartilaginous, coated externally with microscopic hyaline hairs and formed of a central articulated filament and two strata; the intermediate stratum composed of longitudinal, branching, excurrent filaments; the cortical membranous, of roundish-angular cells. Cystocarps immersed in the ramuli, containing moniliform spore-threads issuing from a central placenta. Tetrasporangia zonate, in wart-like nemathecium.

Dasyphloea tasmanica Harvey.

Attachment discoid. Frond softly cartilaginous, rose red, decompound, much branched; branches irregularly inserted, repeatedly divided, narrowed towards each extremity and beset with small setaceous ramuli. Frond 15 cm. to 25 cm. long, and as much in the expansion of the branches. The principal stem is either simple or divided into two or more branches, which are simple or forked. These throw off, laterally, numerous secondary, patent branches of unequal length, tapering at base and apex, flexuous and subacute; ultimate ramuli setaceous. Cystocarps formed two together in the ultimate ramuli, which then become fusiform. Adheres to paper.

Victoria (Port Phillip), Tasmania.



Fig. 193.—*Dasyphloea tasmanica*: a, plant; b, a small branchlet, with fertile ramuli; c, cross-section of the frond; d, cross-section through a fertile ramulus, showing the binate cystocarps; e, one of the excurrent filaments; f, some spore threads from the cystocarps. (After Harvey.)

Family NEMASTOMACEAE (J. Agardh) Schmitz.

NEMASTOMA J. Agardh.

Frond compressed, between fleshy and gelatinous, dichotomous, composed of two strata; the medullary stratum of longitudinal, interwoven filaments; the peripheric of dichotomo-fastigate, articulate, filaments, lying in firm gelatine. Cystocarps immersed below the cortical filaments, containing filaments and numerous rounded spores; cruciate tetrasporangia dispersed among the cortical filaments.

Nemastoma (?) comosa Harvey.

Frond very long, to 2 meters, linear, compressed, distantly forked; the segments elongate, simple, densely fringed with subdistichous or scattered, slender, filiform, basally and apically attenuated ramuli. Cystocarps and tetrasporangia both immersed in the ramuli of different plants.

Attachment a small disc. Frond to 2 meters long; branches simple, to 1 meter long. The axils rounded and apices attenuated; throughout the



Fig. 194.—*Nemastoma comosa*: a, base of a six-foot long frond; b, segment of a transverse cutting of a ramulus, showing two favellae lying beneath the excurrent peripheric threads; c, some spores. (After Harvey.)

whole frond the margin is densely fringed with slender branches, 2 cm. to 10 cm. long; these ramuli taper to the base and apex; the frond is composed wholly of filaments; those of the axis are longitudinal, densely packed, interwoven and in firm gelatine; those of the periphery are many times forked. Cystocarps are immersed in the ramuli at the base of the peripheric filaments. Tetrasporangia on separate plants, hidden among the extremities of the filaments of the ramuli, cruciate. Colour dull brownish-purple. This is the largest species of the genus.

Victoria (Western Port).

Nemastoma Feredayae Harvey.

Frond gelatinous, lubricous, cylindrical-compressed, irregularly dichotomous, subfastigate; ramuli regular, lateral; segments erect, slightly narrower; proliferous ramuli attenuated, many issuing subdistichously from near the margin of the compressed rachis.

South Australia (Encounter Bay), Victoria, Tasmania.

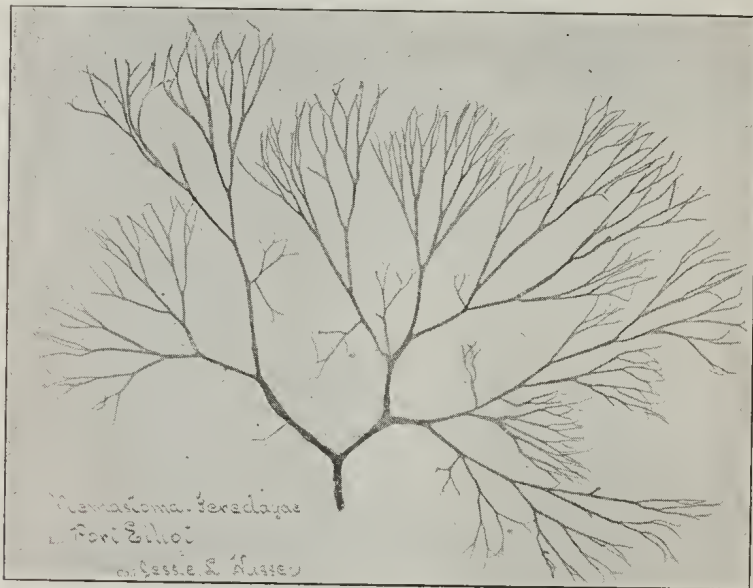


Fig. 195.—*Nemastoma Feredayae*.

Nemastoma palmata Harvey.

Attachment a small, scutate disc. Frond 10 cm. to 15 cm. long, membranous, thickish, irregularly palmatifid, subdichotomous; laciniae lanceolate-linear, subarcuate, spreading; medullary tissue very lax. Colour when dry a dull purplish-red. The substance, though very soft, when fresh is membranous, and even papery when dry. Adheres imperfectly to paper.

Tasmania.

Family RHIZOPHYLLIDACEAE (Montagne) Schmitz.

CHONDROCOCCUS Kützing.

Frond compressed, ancipitous, irregularly pinnate, sometimes subcostate, very gelatinous, somewhat cartilaginous (very easily dissolved), consisting of three layers; an articulate siphon forming the axis, the intermediate layer of oblong-rotund cells, the cortical cells minute, arranged in rows on very short filaments. Cystocarps developed on the tubercles of the frond. Tetrasporangia are formed on the nematheciform tubercles, slightly raised, irregularly cruciate or zonately divided.

Chondrococcus squarrosus Kützing.

Frond elongate, base stipitate, flattened, subdichotomous, segments more or less elongate, slender, linear, slightly dilated towards the apices, patent, pinnate; the pinnae divaricate, unequal, some short and simple, others long and pinnulated. Cystocarps small, immersed or carried laterally. Substance cartilaginous. Colour golden.

Victoria (Phillip Island).

Family SQUAMARIACEAE (Zanard.) J. Agardh.

PEYSSONNELIA Decaisne.

Frond flat, horizontally expanded, rooting by fibres from the lower surface, composed of two strata of cells; the lower stratum of horizontal cylindrical cells, arranged in cohering, longitudinal filaments; the upper of similar cells, set in vertical cohering filaments. Fruits of both kinds lodged in superficial warts (nemathecia); carpospores roundish in moniliform strings; tetrasporangia cruciate.

Peyssonnelia novae-hollandiae (Kütz.) Harvey.

Frond 3 cm. to 5 cm. diameter, fleshy-membranous, the whole frond affixed at the base, otherwise free and covered to the margin with a calcareous crust; deeply incised, multifid, the laciniae expanded in circles, each lacinia narrow below and sublinear, cuneately dilated above and multifid; margin reflexed. Nemathecia expanded widely above the surface of the frond, depressed-plane, carrying tetrasporangia among the very fine filaments; tetraspores large, pyriform and cruciate. Colour purplish. Does not adhere to paper.

South Australia.

Peyssonnelia australis Sonder.

Frond affixed at the base, otherwise free, coriaceous, dark red, flabelliform, zonate, entire; the superior margin thin and often reflexed; the lower surface tomentose with reddish fibrils. Nematocyst scattered, purple.

Attachment a disc. Upper surface of the frond glabrous; somewhat shiny and ridged at short intervals with lines of growth. The under surface thickly clothed, except on the younger portion near the edge, with a rusty tomentum of short, slender, jointed hairs. Substance leathery and tough. Does not adhere to paper.

South Australia (Encounter Bay), Victoria, Tasmania.



Fig. 196.—*Peyssonnelia australis*: a, plant; b, vertical section, showing the two strata of which the frond is composed, and some of the fibres of the tomentum. (After Harvey.)

Family CORALLINACEAE (Gray) Harvey.

CONSPECTUS OF THE GENERA.

Thallus provided with a basal disc, incrusting with lime. Rhizoids not penetrating the matrix.

a. Thallus inarticulate.

b. Tetrasporangia in zone-like sori, or collected into conceptacles. *Archaeolithothamnion* (Rothpl.) Foslie. Sporangia subcylindrical or rotund-ovate, undivided or cruciately (?) divided, in zone-like

sori or subimmersed in conceptacles or superficially grouped. *Lithothamnion* Philippi. Sporangia more or less oblong, transversely divided into two-four spores, in superficial conceptacular sori or subimmersed (pericarp with numerous osteoles).

bb. Tetrasporangia evolved in proper conceptacles.

c. Thallus constantly of a single layer of cells, cuticle present or absent, pluristromatic around conceptacles.

Melobesia Lamouroux. Thallus heavily incrustated with lime.

cc. Thallus everywhere pluristromatic, cuticle absent or present.

d. Thallus flexible (slightly incrustated).

Mastophora (Deene.) Harvey. Fronds of thallus large and partly free; below stipitate, above complanate and more or less furcately branching.

dd. Thallus not flexible (strongly incrustated).

Lithophyllum Philippi. Sporangia collected in the marginal region of the disc. Pericarp with a single osteole. No heterocysts in the thallus.

Goniolithon Foslie. Sporangia sparse over the whole bottom of the conceptacle. Pericarp with a single osteole. Heterocysts in the thallus numerous or sometimes sparse.

aa. Thallus articulate, erect, terete or complanate, heavily incrustated, nodes not incrustated.

Amphiroa Lamouroux. Cystocarps protruding, verrucose, sparse and superficial on the articulations.

Cheilosporum (Dene.) Areschoug. Cystocarps terminal, immersed in the apices of horn-like processes.

Corallina (Tourn.) Lamouroux. Cystocarps terminal, immersed in apices of the articulations. Branching pinnate, irregular, or trichotomous.

Jania Lamouroux. Cystocarps terminal, immersed in apices of the articulations. Branching regularly dichotomous.

ARCHAEOLITHOTHAMNION (Rothpl.) Foslie.

Frond sublithothamnion, that is inarticulated, with a calcereous crust. Sporangia cylindrical-reniform, rotund-ovate, undivided, or cruciately divided; sori in zones, conceptacles subimmersed or superficial, more or less regular, with a single apex, elongate, joined together with a muciform covering and separated by continuous walls, at length vanishing. Carpospores in superficial conceptacles, furnished with a thick apical pore.

Archaeolithothamnion mirabile Foslie.

Outer crust more or less orbicular, margin entire or irregularly dentate, or lobate; on account of the many crusts or layers the matrix is often quite covered over; it is up to $1\frac{1}{2}$ cm. thick, somewhat shiny, here and there irregularly and minutely verrucose. Colour yellowish, greenish, or pink.

Victoria (Phillip Island).

LITHOTHAMNION Philippi.

Frond calcareous, becoming stone-like, erect from the crusted hypothallus, tuberiform or bushy, simple or branched, subterete, with a double layer of cells; the cortical cells almost hexagonal, the interior cells oblong-elongate, in transverse zones. Conceptacles of sporangia superficial or subimmersed, scattered over the frond, furnished with an apical pore. Sporangia zonately divided. Conceptacles of carpospores superficial or slightly immersed, conical or subconical, furnished with an apical pore.

Lithothamnion Muelleri Lenormand.

Frond fucoid, matrix enveloped, crusted; ramuli cylindrical or flattened, arranged irregularly. Groups of cystocarps and sporangia in the same frond; conceptacles prominent, abundant, subimmersed. Sporangia obovate, transversely divided in eight sections. Tetrasporangia minute and pyriform.

Australia (Lyall Bay).

Lithothamnion fumigatum Foslie.

Frond crusted, with an indefinite outline, and small dense tubercles. Conceptacles of the sporangia slightly prominent, the centre frequently depressed.

Victoria.

Lithothamnion lichenoides (E. and S.) Heydrich.

Forming foliated patches from 2 cm. to 15 cm. or more in diameter, consisting of numerous overlaying laminae, variously lobed and concentrically striate, resembling a semi-foliaceous lichen. Cystocarps large and very prominent. Colour pale red or creamy.

South Australia (Eastern Bays), Atlantic, Mediterranean, and Australian Oceans.

Lithothamnion lichenoides var. *Patena* (H. and H.) Foslie.

Syn. *Melobesia Patena* Hooker et Harvey.

Fronds $\frac{1}{2}$ cm. to 2 cm. long, fixed by a groove in the base which clasps round the stem to which they are attached, otherwise free, horizontal, flat, or slightly concave, obovate or suborbicular, very entire, with a flat and slightly thickened margin. Cystocarps numerous, scattered, depressed. Colour a deep purplish-red.

South Australia (South Coast of Kangaroo Island, Eastern Bays), New Zealand (usually parasitic on *Ballia callitricha*).

MELOBESIA Lamouroux.

Frond flat, expanding horizontally, crustaceous, affixed below, formed of layers of cells arranged in flabelliform rows. Conceptacles of the carpospores superficial, conical or hemispherical-conical, furnished with an apical pore. Conceptacles of the sporangia superficial or slightly immersed, conical or hemispherical-conical, with apical pores.

Melobesia farinosa Lamouroux.

Frond flat, affixed below, suborbicular, rimose, somewhat scaly, imbricated, quickly confluent, farinose; conceptacles covering the whole frond, hemispherical, abundant, very minute.

South Australia (Investigator Strait), Victoria (Port Phillip), Atlantic, Mediterranean.

Melobesia cymodocea Foslie.

Frond crusted or spotted greyish-red, at first orbicular, then confluent and irregular, monostromatic (except near the conceptacles). Conceptacles of the sporangia solitary or in groups, conical.

Victoria (Port Phillip).

Melobesia coronata Rosan.

Frond orbicular, reniform, slightly lobate, greyish-pink. Conceptacles (of the carpospores ?) one to nine in each layer, often arranged in a circle, conical, with the tufa coronated with strong elongated hairs. On *Pollexfenia pedicellata*.

South Coast of Australia.

MASTOPHORA Decaisne.

Frond thinly calcareous, never fragile, but flexible and tenacious, affixed below, terete, caulescent; above flat and foliaceous, flabelliform, dichotomous or proliferous, composed of subisomorphic cells, subcubical, radiating. Conceptacles scattered over the middle of the frond, hemispherical, moniliform, furnished with an apical pore. Sporangia erect in the bottom of the conceptacles, oblong, including four zonate spores.

Mastophora Lamourouxii Decaisne.

Attachment a large callous disc. Frond 10 cm. to 15 cm. long, the stipe linear, irregularly dichotomous; ramuli merging into the segments at the base, which are narrowly cuneate and incised and vanish into the flabellate apices, which have involute margins and are hoary (pruinose) underneath. Conceptacles numerous. Colour purplish, often greenish.

South Australia (Encounter Bay, Investigator Strait), Victoria (Port Phillip), South Africa, Java.

Mastophora canaliculata Harvey.

Frond 10 cm. to 20 cm. or longer, narrowly linear, dichotomous-multifid, fastigiate, the laciniae linear, or subcanaliculate, margin involute, canaliculate underneath, glabrous, concolorous. Conceptacles grouped thickly below the apices, hemispherical. Colour purplish-brown when dry. Substance calcareous, but flexible; rigid when dry.

South Australia (Eastern Bays), Victoria (Port Fairy), Tasmania.



Fig. 197.—*Mastophora Lamourouxii*.

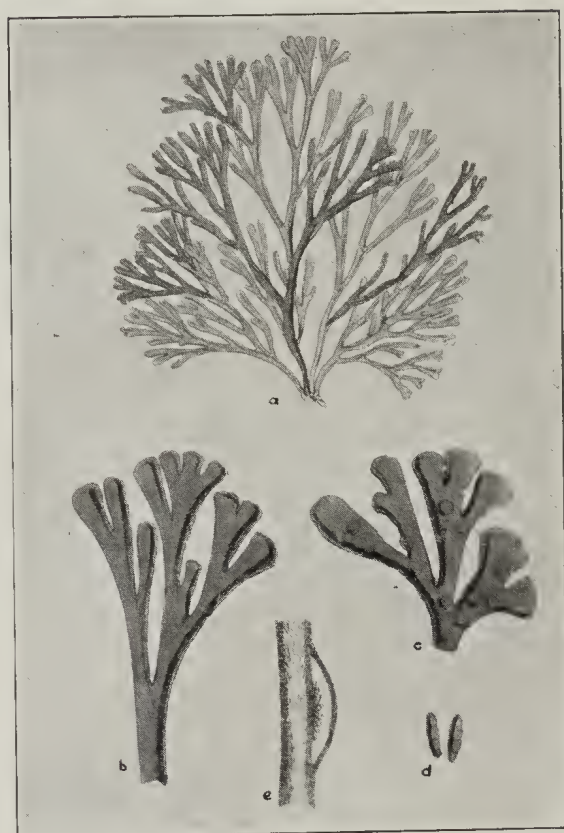


Fig. 198.—*Mastophora canaliculata*: a, plant; b, portion of the frond, lower surface; c, portion of the frond, upper surface, bearing conceptacles; d, spore threads; e, section of the frond and a conceptacle. (After Harvey.)

LITHOPHYLLUM Philippi.

Frond dorsiventral, flat, variously marked or figured, thickly crusted with lime, more or less affixed, margin free or loosely adhering, with many stromae. Conceptacles as in *Melobesia*. Conceptacles of the sporangia immersed or slightly prominent, convex in the central part of the covering, then more or less ecorticate, and finally subdepressed. Conceptacles of the carpospores immersed or slightly prominent, with a short paraphysis in the central fascicle of the carpospores.

Lithophyllum hyperellum Foslíe.

Frond 2.5cm. diameter, sometimes affixed, other times free, subglobose, repeatedly and irregularly branched from the centre; ramuli radiating, short, nodose, very dense, fastigiate, apices often dense. Conceptacles of the sporangia at first convex, not definitely acute, solitary or in small clusters. Tetrasporangia zonately divided.

Victoria (Port Phillip, Western Port).

Lithophyllum amplexifrons (Harv.) Heydrich.

Frond loosely twisted, thick lobate, rugose. Conceptacles very small, immersed, umbilicate, almost porous.

South Australia (Eastern Bays), South Africa.

GONIOLITHION Foslíe.

Frond lithophyllie; heterocysts numerous in the thallus or scattered here and there. Conceptacles of the sporangia are superficial or subimmersed, conical, with elongate apices, or constricted above the middle; the upper part of the sporangia is often cut off when ripe, and the conceptacles are then hemispherical or conical, furnished with a thick apical pore. Sporangia supported on a long pedicel, rising from a somewhat flattened disc at the base; the discs joined by a covering of very fine filaments, often disappearing when fully developed. Conceptacles of the carpospores, superficial, conical, apices often elongated into a thick apical pore.

Goniolithon verrucosum Foslíe.

Frond irregularly crustaceous, verrucose. Conceptacles of the sporangia very dense over the whole surface, hemispherical, or hemispherical-conical.

South Australia (Robe).

Goniolithon elatocarpum Foslíe.

The crust is indeterminate, 10 mm. to 15 mm. in diameter, 2 cm. to 4 cm. thick, often slightly verrucose. Conceptacles of the sporangia have elongate apices, which soon fall off; hemispherical-conical.

Victoria (Western Port).

AMPHIROA Lamouroux.

Frond terete, compressed or flat, calcareous, articulated, dichotomous, pinnated or whorled. Nodes cartilaginous. Conceptacles conical, wart-like, sessile on the disc of the articulations, furnished with an apical pore, and containing in the base of the cavity a tuft of erect, pyriform, at length four-parted spore threads.

Amphiroa granifera Harvey.

Frond di-trichotomous, fastigate; articulations cylindrieal, the lower ones at the base and apices thickly nodose, the upper ones simple; the lower points ealcareous-granulose. the uper ones bare. Coneceptables secund on the ramelli.

Victoria (Port Fairy), West Australia (Cape Riche).

Amphiroa ephedraea (Lamarek) Decaisne.

Frond 25 cm. to 30 cm. long or more, much branched; the lower divisions often triehomotous, the upper divisions and branches dichotomous. All the axils acute, and the branches tapering to the extremity. Articulations in all parts of the frond cylindrical, or the upper ones very slightly compressed, smooth when barren, densely warted all over when in fruit; separated by a naked, cartilaginous, dark-coloured joint. Colour a dull lurid purple, turning to green.

South Australia, West Australia. Victoria, New South Wales. South Africa, Japan.

Amphiroa gracilis Harvey.

Frond elongate, terete, slender, di-trichotomous, fastigate; joints cylindrical, equal, truncate at the base and apex, all very long, 10-14 times as long as broad; nodes naked, as long as broad; whole frond 6 cm. to 10 cm. high. Cystoearps prominent, tubercular, formed not only on the upper, but on the medial and often on the lower articulations; closely placed on every side. Colour when fresh full purple, becoming pale red or white on exposure. Substance very brittle. Does not adhere to paper.

West Australia (Rottnest Island, King George Sound).

Amphiroa charoides Lamouroux.

= *Metagoniolithan charoides* (Lamour.) Weber van Bosse.

Frond 6 cm. to 10 cm. long, forming globose, fastigate tufts, much branched in an irregularly triehotomous or vertieillate manner. Branches not much divided, beset at every joint with numerous whorled ramuli, each of which consists of a single articulation, about 1cm. to 1½ em. in length. Articulations variable in different specimens, 1 cm. to 3 cm. long, very solid and compact. Joints long, naked, supporting the ramuli as if on petioles. Very fragile, usually faded in colour to an ivory white.

South Australia, West Australia, Tasmania.

Amphiroa stelligera (Lamarek) Decaisne.

= *Metagoniolithon stelligera* (Lamarek) Weber van Bosse.

Frond terete, verticillate and triehotomous: ramuli long and umbellately branched at almost every joint; ramelli very slender, joints long or short, nodes cartilaginous, articulations all terete; in the ramuli the articulations are thick at the base and apices, in the ramelli very slender and filiform. Cystocarps more or less in pairs, large.

South Australia (Holdfast Bay, Encounter Bay), West Australia, Victoria (Port Phillip), Tasmania. Common.

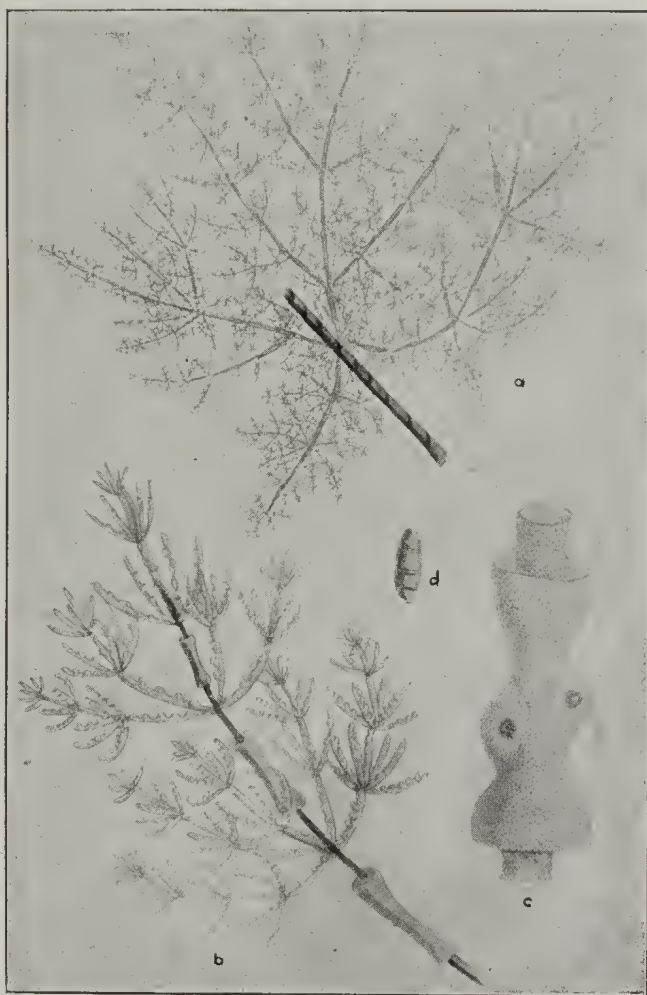


Fig. 199.—*Amphiroa stelligera*: *a*, plant; *b*, part of a branch, with whorled lesser branches and ramuli; *c*, an articulus, with two ceramidia from a main branch, after the lime has been removed by acid; *d*, a tetraspore. (After Harvey.)

CHEILOSPORUM Areschoug.

Frond plano-compressed, calcareous, articulated, dichotomous; articulations ob-sagittate or obovate. Conceptacles ovoid, immersed in the upper margin of the lobes of the articulations, one in each lobe, furnished with an apical pore and containing in the base of the cavity a tuft of erect, four parted spore-threads.

Cheilosporum sagittatum (Lamour.) Areschoug.

Attachment a spreading calcareous disc. Frond robust, stipitate, becoming broader upwards, densely tufted, 5 cm. to 15 cm. high, regularly dichotomous above the middle, flabelliform and fastigiata. Lower articulations



Fig. 200.—*Cheilosporum sagittatum*: a, plant; b, apex of a branch, with ramuli; c, fertile articulations, with ceramidia; d, a fertile lobe, with its ceramidium, after the lime has been removed by acid. (After Harvey.)

obconical, with short oppressed lateral lobes; middle and upper ones deeply sagittate, compressed, tapering at the base, broadly subulate, acute. Terminal articulation of the branches and ramuli obovate. Fruit as above. When the lime is removed by acid, the articulations are elegantly banded by alternate bands of roundish and linear cells. Colour when growing deep purple-red. Substance rigid and fragile. Does not adhere to paper.

South Australia (Encounter Bay, Port Noarlunga), New South Wales (Kiama), Mauritius, South Africa.

Cheilosporum pulchellum Harvey.

Frond dwarf, shortly stipitate, dichotomous, flabelliform, fastigiate, articulations sagittate, cestate in the centre, often transversely rugulose, articulations one and a half times as long as wide, lobes short, acute, erect. West Australia (Rottneest Island).

Cheilosporum Wardii (Harv.) De Toni.

= *Arthrocardia Wardii* Areschoug.

Frond robust, densely pinnulated, with a very wide outline; pinnae and pinnellae very dense, erecto-patent, shorter above; articulations scarcely longer than wide, thickened at the base, compressed-terete, almost quadrate, compressed in the middle forming a cuneate-deltoid hexagon with obtuse angles, quadrate above; articulations of the ramuli cuneate or oblong, compressed, the final ones elliptic and very obtuse.

Victoria (Port Phillip), East Coast, Tasmania.

Cheilosporum Mallardiae (Harv.) De Toni.

= *Arthrocardia Mallardiae* Areschoug.

Frond robust, densely pinnulated with a very wide outline, pinnae and pinnellae very dense, erecto-patent, shorter above, final pinnellae slender, attenuated, and terete. Articulations nearly twice as long as they are wide, thickened at the base, compressed in the middle, forming a cuneate-deltoid hexagon, with obtuse or slightly acute angles, cuneate above; articulations of the ramuli cylindrical, filiform, with acute apices.

Victoria (Port Phillip).

JANIA Lamouroux.

Frond subterete, setaceo-filiform, calcareous, articulated, dichotomous; articulations cylindrical or compressed. Conceptacles urn-shaped, formed in the forks of the upper branches, furnished with an apical pore, containing in the base of the cavity a tuft of erect, four parted spore-threads.

Jania fastigiata Harvey.

Attachment crustaceous. Frond 4 cm. to 8 cm. high, fastigiate, dichotomous, with very acute axils, densely tufted, to a mm. thick. Branches straight, erect, apices frequently a little distended, swollen, sphacelate; articulations cylindrical, nodes constricted. The cystocarps are formed abundantly in most of the upper axils of fertile specimens by the transmutation of the axile cell, and are exactly urn-shaped, with a projecting orifice. Spore-threads slightly club-shaped, composed of four spores. Colour when fresh deep purplish-red. Substance rigid and rather fragile. Does not adhere to paper.

South Australia (Robe), Victoria (Port Fairy), South Africa.

Jania micrarthrodia Lamouroux.

Frond short, caespitose, axils patent, dichotomous; ramuli subarcuate, divaricate; articulations subcylindrical, moniliform. Conceptacles subglobose-elliptic at the apices; protuberance elongated.

South Australia (Encounter Bay, Investigator Strait), Victoria (Port Phillip), West Australia, Tasmania, New Zealand.

Jania rubens Lamouroux.

Fronds 1 cm. to 5 cm. high, densely tufted, dichotomous, many times forked, fastigate; branches erect or spreading, gradually attenuated towards the apices. Articulations everywhere cylindrical, without prominent angles; those near the base very short, the upper ones gradually longer; those in the middle parts of the frond from four to five times longer than broad. Apical articulations acute or obtuse, sometimes much

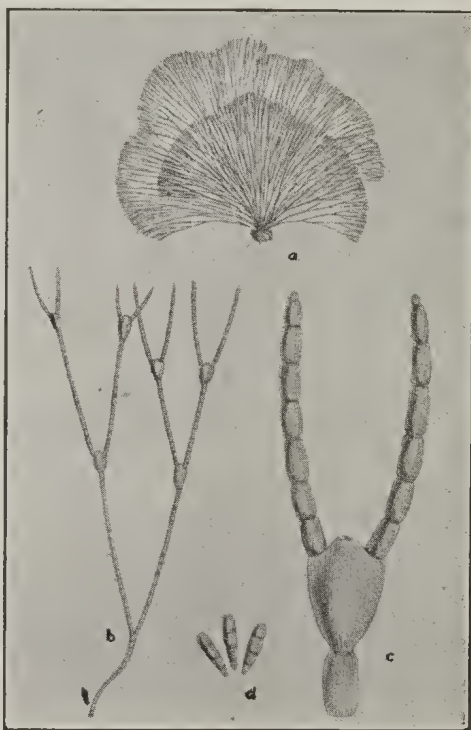


Fig. 201.—*Jania fastigiata*: a, plant; b, upper branches, with ceramidia in the forks; c, a ceramidium, with its two terminal ramuli, after the lime has been removed by acid; d, spore threads. (After Harvey.)

attenuated. Cystocarps subterminal, urn-shaped, with long horns formed of from two to four articulations. Colour pale red, purplish when quite fresh.

South Australia (St. Vincent Gulf, Encounter Bay, Eastern Bays), Atlantic, Mediterranean and Southern Oceans.

CORALLINA (Tournefort) Lamouroux.

Frond caespitose, primary frond pinnately branched, ramuli subtripinnate; pinnae edged with elongate pinnellae; the pinnellae simple, equithick, or subclavate; articulations of the ramuli and pinnae compressed or compresso-euncate, of the pinnellae cylindrical. Conceptacles ovate, subspherical, with long pedicels, ecorneulate.

Corallina Cuvieri Lamouroux.

Frond wide, rigid; primarily branched ramuli are subtripinnate, pinnæ issuing from the apices of the articulations; pinnellæ are multifid or pinnulated, terete or compressed, patent; articulations of the ramuli are subcompressed, subelliptic, or subcuneate; the articulations of the pinnæ are compressed, cuneate, almost three times as long as wide. Conceptacles

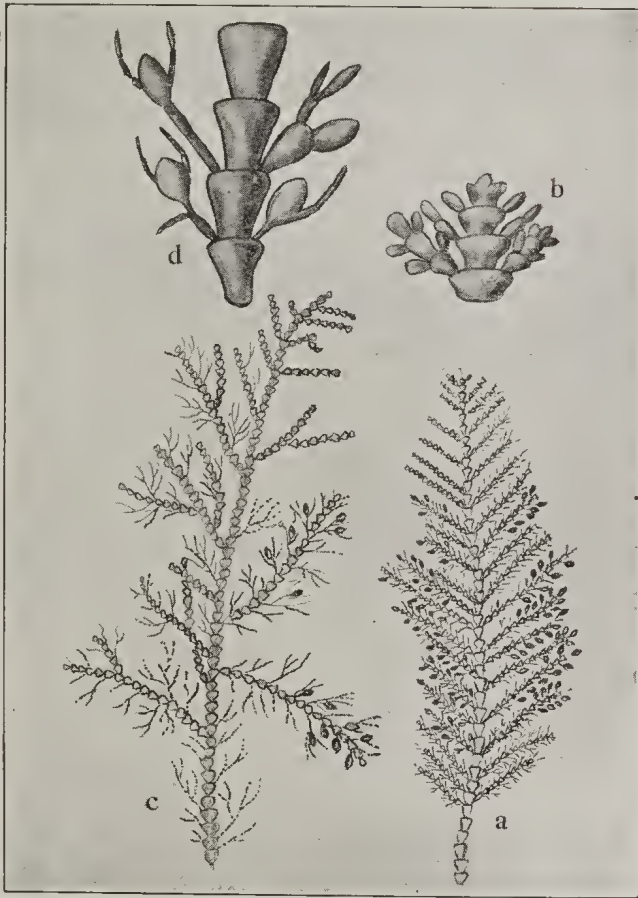


Fig. 202.—*Corallina Cuvieri*: a, part of a plant, enlarged; b, apex of a frond; c, d, var. *crispata*; c, part of a frond, enlarged; d, apex, showing cystocarps.

ecorniculate and oblong, or corniculate and suburceolate. Furnished with an apical pore.

South Australia (Encounter Bay, Investigator Strait, Holdfast Bay), common on the West, South and East Coasts, Tasmania, New Zealand.

This species is extremely polymorphic and numerous varieties have been made out of it. Until a large range of specimens from many localities can be examined it is scarcely worth while separating the supposed varieties; these include var. *crispata* Areschoug, var. *subulata* Areschoug, and var. *denudata* Sonder, all recorded from the south coast of Australia. The

following species have also been described, but are very doubtfully distinct from *C. Cuvieri*: *C. calliptera* Kützinger, *C. plumifera* Kützinger, *C. granifera* Ell. and Soland, and *C. clavigera* Kützinger.

Corallina Lenormandiana Grun.

= *C. nana* Lenormand = *C. pusilla* Sonder.

Fronde epiphytic, dwarf, di-trichotomous, fastigiate; articulations cuneate, twice as long as wide.

Victoria (Port Fairy, Port Phillip).

Corallina pilifera Lamouroux.

Fronde flaccid, primarily branched, ramuli bipinnate, pinnae a little below the apices, with pinnellae issuing from the articulations; pinnellae simple or subdichotomously branched, filiform, curved, arcuate; articulations of the ramuli elliptic or cuneate-submoniliform, and of the pinnae subcompressed, cuneate, twice as long as wide. Conceptacles subglobose-pyriform, furnished with an apical pore, piliferous, corniculate.

South Australia (Port Adelaide).

APPENDICES.

I.—Class CHLOROPHYCEAE ("Green Algae").

The great majority of the Chlorophyceae (some 90 per cent) are fresh-water inhabitants, the remainder being marine, but all are included in the one classification. Phycologists are in general agreement concerning the natural affinities of many groups of genera, but there is great diversity of opinion concerning the limits of groups larger than the family. In Part I. of "The Seaweeds of South Australia" Lucas gave a description of the marine Chlorophyceae of this State, but the classification he used is now outmoded. In this appendix the common Chlorophyceae found in South Australia are listed, together with the localities from which they have been collected. The system of classification followed is that given by G. M. Smith in his "Cryptogamic Botany", Vol. I. (1938), as being representative of modern ideas on the systematics of the Chlorophyceae. For descriptions of the genera and species, Part I. of "The Seaweeds of South Australia" must be consulted.

Eleven orders may be recognized.

I. VOLVOCALES.

The only Chlorophyceae in which the vegetative cells are flagellated and actively motile. All are fresh-water forms.

II. TETRASPORALES.

Vegetative cells immobile, usually united in non-filamentous colonies that are either amorphous or of a definite shape. All are fresh-water forms.

III. ULOTRICHALES.

Cells uninucleate, with a single parietal laminate chloroplast, united end to end in simple or branched filaments. Asexual reproduction by zoospores; sexual by union of isogamous, anisogamous, or oogamous gametes. A few marine species, but the majority are fresh-water forms, comprising several families.

Family CHAETOPHORACEAE.—Thallus branching, filamentous, branches free or pressed together into a pseudo-parenchymatous tissue. Terminal cell may be prolonged into a long colourless seta. Cells uninucleate, with a single parietal chloroplast.

Entocladia Reinke, 1879 (= *Endoderma* Lagerheim, 1883).

Ent. viridis Reinke (= *End. viride* Lagerheim). Eastern Bays.

IV. ULVALES.

Cells uninucleate, dividing in two or in three planes to produce a parenchymatous thallus that may be an expanded sheet, a hollow tube, or a solid cylinder. Asexual reproduction by means of quadriflagellate zoospores; sexual by biflagellate gametes, either isogamous or anisogamous. This order includes only one family, the Ulvaceae, which is included by some authorities in the Ulotrichales because of similarities in cell structure and reproduction.

Ulva Linnaeus.

U. lactuca Linnaeus. Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bay (probably occurs all along South Australian coast).

U. rigida C. Agardh. Investigator Strait. Sometimes considered as a variety of *U. lactuca* Linnaeus.

U. linza Linnaeus. Investigator Strait. Sometimes placed in *Enteromorpha* as the stipe is usually hollow but not the blade.

Enteromorpha Link.

E. compressa (L.) Greville. Holdfast Bay, Encounter Bay, Eastern Bays.

E. intestinalis (L.) Link. Encounter Bay.

E. crinita (Roth.) J. Agardh. Eastern Bays.

E. clathrata (Roth.) J. Agardh. Holdfast Bay, Encounter Bay, Eastern Bays.

V. SCHIZOGONIALES.

Thallus filamentous, plate-like, or as solid cylinders. Cells uninucleate, with a single stellate chloroplast. Some marine species, but none recorded from South Australia.

VI. CLADOPHORALES.

Multicellular forms, with the cells united end to end in simple or branching filaments. Cells always multinucleate, with numerous discoid chloroplasts which may be free or united by strands. Asexual reproduction by zoospores or non-motile spores; sexual reproduction either isogamous or oogamous. Both marine and fresh-water species are known. This order was formerly placed in the Siphonocladiales, but appears to be related to the Ulotrichales, and is now considered a distinct order.

Family CLADOPHORACEAE.—Chloroplasts evenly distributed in the cytoplasm of the cells.

Chaetomorpha Kützing.

C. Darwinii (H. & H.) Kützing. Holdfast Bay, Encounter Bay, Eastern Bays.

C. coliformis Montagne. Encounter Bay.

C. aerea (Dillw.) Kützing. Port Noarlunga.

Cladophora Kützing.

C. valonioides Sonder. Investigator Strait, Encounter Bay.

C. nitidula Sonder. Investigator Strait.

C. conformis Reinbold. Eastern Bays.

C. Daveyana Reinbold. Investigator Strait.

VII. OEDOGONIALES.

Cells uninucleate, serially united in simple or branched filaments. This order is distinguished by their unique method of cell division, involving annular splitting of the lateral wall. All species are fresh-water in habit.

VIII. CONJUGALES.

Cells solitary or in chains. Characterized by lack of flagellated reproductive cells, and sexual reproduction by means of amoeboid gametes. All are fresh-water forms.

IX. CHLOROCOCCALES.

Cells solitary or colonial, with either a definite or indefinite number of cells in a non-filamentous colony. Vegetative cell division does not occur. Nearly all species are fresh-water inhabitants, many forming the plankton of ponds and lakes.

X. SIPHONALES.

Unicellular, multinucleate (coenocytic) algae in which the cell is generally a branched tube capable of indefinite elongation. Cytoplasm lines the wall and bounds a continuous central vacuole. Within the cytoplasm are situated many discoid chloroplasts and numerous nuclei. Asexual reproduction by fragmentation of the thallus; sexual by isogamous, anisogamous, or oogamous gametes. Most of the genera are marine, and are found in tropical or subtropical seas. South Australian representatives belong to three families:

1. Family BRYOPSIDACEAE.—Thallus unseptate and differentiated into a prostrate rhizome-like portion and an erect pinnately branched portion.

Bryopsis Lamouroux.

B. plumosa (Huds.) C. Agardh. Encounter Bay, Investigator Strait, Eastern Bays.

B. vestita J. Agardh. Eastern Bays.

2. Family CAULERPACEAE.—Thallus one-celled with a rhizome-like portion bearing root-like appendages on its lower face and erect shoot-like appendages on its upper face. The family includes but one genus.

Caulerpa Lamouroux.

C. scalpelliformis (R. Br.) C. Agardh. Encounter Bay, Eastern Bays.

C. longifolia C. Agardh. Encounter Bay, Investigator Strait.

C. Harveyi F. von Mueller. Investigator Strait, Eastern Bays, Encounter Bay.

C. Cliftoni Harvey. Encounter Bay, Investigator Strait.

C. obscura Sonder. Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays.

C. trifaria Harvey. Holdfast Bay, Encounter Bay, Eastern Bays.

C. Brownii Endlicher. Encounter Bay, Investigator Strait, Eastern Bays, Great Australian Bight.

C. Hedleyi W. van Bosse. Off Kangaroo Island.

C. hypnoides (R. Br.) C. Agardh. Encounter Bay, Investigator Strait, Eastern Bays.

C. Muelleri Sonder. Doubtfully distinct from *C. hypnoides*. Similar localities.

II.—Class PHAEOPHYCEAE (“Brown Algae”).

The Phaeophyceae constitute the group of “Brown Algae” in which the green of the chlorophyll in the plastids is masked by the two brown pigments fucoxanthin α and β . They form a quite well-marked group upon which a good deal of cytological investigation has been carried out, so that the life-cycles of the majority of the genera are well known. Within the group there are three definite types of life-cycles (now forming the basis of their classification), and these can be represented by *Ectocarpus*, *Dictyota*, and *Fucus*.

The standard classification of the Brown Algae prior to the early 1920's had always been that of Oltmann's (1904-1905) or of Kjellmann (1891) in Engler and Prantl, but in 1915-1916 and the years following Sauvageau, quickly followed by Kylin, began to throw an entirely new light upon the life histories of the Browns, particularly the kelps for which a microscopic oogamous gametophyte was discovered for *Laminaria*. This promoted a series of enthusiastic searches for missing sporophytes or gametophytes of various species and the elucidation of their life histories, and this steadily increasing flood of data necessitated that the group be viewed from an entirely different standpoint, and that the primary classification be overhauled. In 1922 Prof. W. Randolph Taylor suggested that such a classification could well be based upon the nature of the life-cycle and formulated a classification of a tentative nature embodying this, in contrast to all previous classifications which had been based upon the structure and means of reproduction. The new classification, however, was not sufficiently complete to serve all practical needs, and with later research rapidly became obsolete. Various phycologists offered their preferences, and in 1925 W. A. Setchell and N. L. Gardner produced a classification essentially from a systematic viewpoint, while in 1933 Dr. Harold Kylin put forward a classification from the developmental standpoint. This latter classification was supported by Taylor in 1936, and appears to be the most nearly natural yet advanced and is gradually receiving universal support. In this short review are briefly outlined the Taylor (1922) and the Setchell and Gardner (1925) classifications followed by a census of the known South Australian Brown Algae in the Kylin (1933)-Taylor (1936) classification so that the nature of each may be compared.

- C. sedoides* (R. Br.) C. Agardh. Eastern Bays, Normanville.
C. vesciculifera Harvey. Eastern Bays.
C. simpliciuscula C. Agardh. Encounter Bay, Kangaroo Island.
C. cactoides (Turn.) J. Agardh. Encounter Bay, Investigator Strait, Eastern Bays.

3. Family CODIACEAE.—Thallus freely branched, tubular; branches interwoven to form a thallus of definite macroscopic form.

Codium Stackhouse.

- C. Lucasii* Setchell. "South and east coasts of Australia"—Lucas. Pennington Bay, Kangaroo Island.
C. spongiosum Harvey. Holdfast Bay, Encounter Bay, Port Lincoln.
C. pomoides J. Agardh. Holdfast Bay, Encounter Bay.
C. mammillosum Harvey. Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays.
C. Muellieri Kützinger. Holdfast Bay, Encounter Bay, Investigator Strait, Eastern Bays.
C. galeatum J. Agardh. Encounter Bay.
C. fragile (Sur.) Hariot. Robe, Encounter Bay.

XI. SIPHONOCCLADIALES.

Thallus siphonaceous when young, later becoming partitioned into a number of multinucleate segments. Asexual reproduction by vegetative multiplication, rarely zoospores; sexual by biflagellate isogametes. All species are marine.

Family VALONIACEAE.—All cells except the rhizoids are more or less similar in form.

Dictyosphaeria Decaisne.

- D. sericea* Harvey. Holdfast Bay, Encounter Bay, Investigator Strait.

Apjohnia Harvey.

- A. lactevirens* Harvey. Encounter Bay, Investigator Strait, Eastern Bays.

Struvea Sonder.

- S. macrophylla* Harvey. Encounter Bay, Investigator Strait.
S. plumosa Sonder. Port Noarlunga.

A.—CLASSIFICATION ACCORDING TO RANDOLPH TAYLOR (1922).

(A) PHAEOSPORALES.—Gametes isogamous or anisogamous. Three sub-orders.

(i.) ECTOCARPINEAE.—Morphological alternation of similar generations shown or inferred to be present. Eight families.

Ectocarpaceae, *e.g.*, *Ectocarpus*.

Tilopteridaceae.

Sphacelariaceae, *e.g.*, *Sphacelaria*, *Cladostephus*.

Asperococcaceae, *e.g.*, *Asperococcus*, *Scytosiphon*.

Chordariaceae.

Desmarestiaceae.

Stilophoraceae.

Ralfsiaceae.

(ii.) DICTYOSIPHONINEAE.—Morphological alternation of dissimilar generations present or inferred, the sporophyte exceeding the gametophyte in size.

Dictyosiphonaceae.

(iii.) CUTLERINEAE.—Morphological alternation of similar or dissimilar generations present or inferred, with gametophyte, when different, larger than the sporophyte.

(B) CYCLOSPORALES.—Plants of this order strictly oogamous.

(i.) DICTYOTINEAE.—Morphological alternation of similar generations.

Dictyotaceae, *e.g.*, *Dictyota*, *Zonaria*.

(ii.) LAMINARINEAE.—Morphological alternation of dissimilar generations with gametophyte smaller than sporophyte.

Laminariaceae, *e.g.*, *Ecklonia*.

(iii.) FUCINEAE.—Alternation of generations reduced to cytological.

Fucaceae, *e.g.*, *Sargassum*, *Hormosira*.

B.—CLASSIFICATION ACCORDING TO SETCHELL AND GARDNER (1925) (MELANOPHYCEAE (PHAEOPHYCEAE)).

(A) PHAEOSPOREAE.—Reproduction both sexual and asexual, but aplanospores unknown; typically unilocular zoosporangia and plurilocular gametangia present.

(i.) SPHACELARIALES.

Sphacelariaceae, *e.g.*, *Sphacclaria*.

Cladostephaceae, *e.g.*, *Cladostephus*.

Stypocaulaceae, *e.g.*, *Stypocaulon*.

(ii.) ECTOCARPALES.

Elachisteaceae.

Myrionemataceae.

Ralfsiaceae.

Leathesiaceae, *e.g.*, *Leathesia*.Asperococcaceae, *e.g.*, *Asperococcus*.

Punctariaceae.

Scytosiphonaceae, *e.g.*, *Scytosiphon*, *Colpomenia*.Ectocarpaceae, *e.g.*, *Ectocarpus*, *Pylaiella*

Striariaceae.

Aegiraceae.

Chnoosporaceae.

Heterochordariaceae.

(iii.) CUTLERIALES.

Cutleriaceae.

(iv.) SPOROCHNALES.

Sporochnaceae, *e.g.*, *Sporochnus*, *Carpomitra*.

(v.) DESMARESTIALES.

Desmarestiaceae.

Myriogloiaceae.

(vi.) CHORDARIALES.

Chordariaceae.

Coilodesmaceae.

Scytothamnaceae.

(vii.) LAMINARIALES.

Chordaceae.

Laminariaceae.

Lessoniaceae, *e.g.*, *Macrocystis*.Alariaceae, *e.g.*, *Ecklonia*.

(B) APLANOSPOREAE.—Reproduction both sexually and asexually, but with non-motile aplanospores present; reproductive organs on the surface of the thallus.

(i.) TILOPTERIDALES.

Tilopteridaceae.

(ii.) DICTYOTALES.

Dictyotaceae, *e.g.*, *Dictyota*, *Zonaria*, *Padina*, etc.

(C) CYCLOSPOREAE.—Reproduction sexual only with reproductive organs located within the thallus in conceptacles with paraphyses.

FUCALES.

Sargassaceae, *e.g.*, *Sargassum*, *Cystophora*, *Scaberia*, *Scytothalia*.

Fucaceae, *e.g.*, *Hormosira*, *Notheia*, *Myriodesma*.

CENSUS OF KNOWN SOUTH AUSTRALIAN BROWN ALGAE.

CLASSIFICATION ACCORDING TO KYLIN (1933) AND TAYLOR (1936).

PHAEOPHYCEAE Hauck 1885.—Plants multicellular, varying from simple or branched filaments and single-layered membranes to solid bodies made up of differentiated tissues; cells typically uninucleate, with distinct walls, containing olive-brown chromatophores; internal cells in higher forms elongated and forming definite mechanical conducting and storage systems; outer tissues consisting of absorbing and assimilatory cells; life-cycle exhibiting a definite morphological alternation of similar or dissimilar generations, or in the Fucales a cytological alternation of generations; gametophytes producing similar gametes or sperms and eggs; sporophyte producing spores in sporangia, following meiosis.

(A) ISOGENERATAE Kylin 1933.—Morphological alternation of similar generations known or inferred to be present. There are five orders.

(i.) ECTOCARPALES Oltmanns 1922.—Plants generally filamentous, branched and uniseriate with an apical, trichothallic, but more usually an intercalary growing point; sporophyte and gametophyte phases similar in appearance, reproducing by iso- or aniso-gametes; sporophyte phase bearing spores in multiples of four in sporangia. There are three families (of which only one is represented in South Australia), including about four or five genera, but sometimes they are all placed in the one family.

ECTOCARPACEAE Harvey 1852.

Ectocarpus Lyngbye 1819.

E. confervoides (Roth.) Le Jol. Holdfast Bay, Investigator Strait.

(ii.) SPHACELARIALES Oltmanns 1922.—Plants generally filamentous, branched and polysiphonious; growth from large apical cells, the segments from which generally divide longitudinally in a regular and characteristic fashion; sporophyte and gametophyte phases of similar appearance reproducing by zoospores and by iso- or aniso-gametes. About 10 genera and 60 species.

SPHACELARIACEAE Reinke emend. Oltmanns 1922.

Sphacelaria Lyngbye 1819.

S. furcigera Kützting 1855. Eastern Bays.

Cladostephus C. Agardh 1817.

Cl. verticillatus (Lightf.) C. Agardh. Eastern Bays, Encounter Bay, Port Noarlunga, Holdfast Bay.

Taylor (1937) believes that *Cl. spongiosus* (Lightfoot) C. Agardh is not distinct enough from the above to be segregated from it, and we have followed him in this respect.

Stypocaulon Kützing 1843.

S. funiculare (Mont.) Kützing. Eastern Bays.

S. paniculatum (Suhr.) Kützing. Eastern Bays, Encounter Bay, Holdfast Bay.

- (iii.) TILOPTERIDALES Kylin 1917.—Plants filamentous, branched and polysiphonious; growth trichothallie or localized intercalary, the segments ultimately undergoing limited longitudinal division; sporophyte and gametophyte phases of similar appearance; the reproductive history somewhat confused, but apparently involving sperms and eggs. About five genera and 10 species.

TILOPTERIDACEÆ Thuret 1855. Not known to be represented here.

- (iv.) CUTLERIALES Oltmanns 1922.—Sporophyte and gametophyte phases of similar or dissimilar appearance, where different the gametophyte being larger than the sporophyte; plants monoecious or dioecious, disc-like to ribbon-like with entire or lobed margins; growth trichothallie; reproduction by iso- or aniso-gametes and spores in sporangial sori.

CUTLERIACEÆ Zanardini 1843. Not known to be represented here.

- (v.) DICTYOTALES Kjellman 1893.—Sporophyte and gametophyte phases of similar appearance; plants monoecious or dioecious bearing sperms and eggs aggregated into definite sori; sporophyte producing tetrads of non-motile spores in sporangia. About 18 genera and 100 species.

DICTYOTACEÆ Harvey 1852.

Gymnosorus J. Agardh.

G. variegatus (Lamour.) J. Agardh. Holdfast Bay.

G. nigrescens (Sond.) J. Agardh. Port Noarlunga, Holdfast Bay, Investigator Strait.

Homoeostrichus J. Agardh.

H. spiralis J. Agardh. Encounter Bay, Port Noarlunga.

H. stuposus (R. Br.) J. Agardh. Eastern Bays.

H. canaliculatus J. Agardh. Eastern Bays.

Zonaria (C. Ag.) J. Agardh 1872.

Z. Turneriana J. Agardh. Eastern Bays, Encounter Bay, Port Noarlunga, Investigator Strait.

Z. crenata J. Agardh. Eastern Bays, Holdfast Bay, Port Noarlunga, Investigator Strait.

Z. Diesingiana J. Agardh. Eastern Bays.

Some authors (e.g., Setchell and Gardner 1925) include both *Gymnosorus* and *Homoeostrichus* under *Zonaria*, believing that J. Agardh's segregation is unwarranted, and although we recognize that the three genera are very closely related we have followed Agardh here. It is interesting to note the name *Zonaria* is really a misprint for *Zornia* in J. G. Agardh's 1872 monograph, but the name has been accepted by the International Committee and cannot be changed.

Chlanidophora J. Agardh 1894.

C. microphylla (Harv.) J. Agardh. Eastern Bays.

In J. Agardh's 1894 monograph the name *Chlanidote* appears in the key instead of *Chlanidophora*, and de Toni and some other authors have called the genus *Chlanidote*, but as Setchell and Gardner (1925) point out the correct generic title is *Chlanidophora*.

Padina Adanson 1763.

P. Pavonia Gaill. Would be expected to be found here, but has not as yet been definitely collected.

Harvey includes *P. Frazeri* in his *P. Pavonia*.

Neurocarpus Web. and Mohr 1805. Synonyms:

Dictyopteris Lamouroux 1809; *Haliseris* Targioni Tozzetti 1819.

N. acrostichoides J. Agardh. Eastern Bays.

N. Muelleri Sonder. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.

N. pardalis Harvey. Port Noarlunga.

Dictyota Lamouroux 1809.

D. latifolia J. Agardh. Investigator Strait.

D. ocellata J. Agardh. Investigator Strait.

D. radicans Harvey. Eastern Bays, Encounter Bay, Investigator Strait.

D. polyclada Kützinger. Spencer Gulf (recorded by Tepper).

Pachydictyon J. Agardh.

P. furcellatum (Harv.) J. Agardh. Eastern Bays, Gulf St. Vincent.

P. paniculatum J. Agardh. Encounter Bay.

Dilophus J. Agardh.

D. fastigiatus (Sond.) J. Agardh. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.

D. marginatus J. Agardh. Encounter Bay.

Lobospira Areschoug.

L. bicuspidata Areschoug. Eastern Bays, Encounter Bay, Investigator Strait.

(B) HETEROGENERATAE Kylin 1933.—Morphological alternation of dissimilar generations known or inferred to be present, with the gametophyte reduced to microscopic size. This class is generally divided into the two sub-classes *Haplostichineae* and *Polystichineae*, but some workers believe this division is rather artificial.

(a) HAPLOSTICHINEAE (Kueckuck) Kylin 1933.—The sporophyte shows trichothallie growth, the thallus being composed of filaments, free from one another, interwoven, or densely compacted into a pseudo-parenchymatous thallus. The microscopic gametophyte is either isogamous (*i.e.*, produces isogametes) or oogamous (*i.e.*, reproduces by production of sperms and eggs), while the macroscopic sporophyte may produce zoospores or aplanospores. There are three orders.

(i.) CHORDARIALES Setchell and Gardner 1925.—Sporophytes are trichothallie and composed of filaments not markedly compacted into a pseudo-parenchymatous thallus, but generally of adherent branches. Gametophytes are microscopic, monoecious, and isogamous. There are three families.

CHORDARIACEAE (Reichenbach) Setchell and Gardner 1925.

LEATHESIIACEAE Setchell and Gardner 1925.

Leathesia Gray 1821.

L. difformis Areschoug. Encounter Bay.

Corynophloea Kützinger.

C. cystophorae J. Agardh. Encounter Bay.

(ii.) SPOROCHNALES.—Sporophyte consisting of a number of adherent filaments of cells, each branch terminating in a tuft of hairs; sporangia borne terminally, usually in dense clusters; microscopic gametophyte monoecious and oogamous (*i.e.*, produces sperms and eggs). There are six genera with about 25 species.

SPOROCHNACEAE (Reichenbach) Decaisne 1842.

Sporochnus C. Agardh.

S. comosus C. Agardh. Eastern Bays, Encounter Bay, Investigator Strait.

S. gracilis J. Agardh is only a slender form of *S. comosus*, and is not recognized by De Toni. Same localities as *S. comosus*.

S. radiciformis (R. Br.) C. Agardh. Eastern Bays.

S. scoparius Harvey. Eastern Bays, Encounter Bay.

Perithalia J. Agardh.

P. inermis (R. Br.) J. Agardh. Eastern Bays, Encounter Bay.

Encyothalia Harvey.

E. Cliftoni Harvey. Eastern Bays, Encounter Bay, Investigator Strait.

It might be expected that *Carpomitra mitriformis* would be found along our coastline, but as yet it has not been discovered.

- (iii.) DESMARESTIALES Setchell and Gardner 1925.—Plants of filamentous construction, the branches showing sub-apical trichothallic growth, and the filaments developing uniaxial branches, often with considerable cortication; reproduction by zoospores borne in unilocular sporangia from which develop microscopic filamentous oogamous gametophytes. There are only three genera in the one family.

DESMARESTIACEAE (Thuret) Kjellman 1880. Not known to be represented here.

- (b) POLYSTICHINEAE (Kuckuck) Kylin 1933.—The sporophyte has a parenchymatous thallus produced by vertical and transverse division of intercalary cells, growth never being trichothallic; reproduction is by zoospores or aplanospores (neutral spores). The gametophytes are microscopic and either isogamous or anisogamous. The sub-class is divided into three orders.

- (i.) PUNCTARIALES Kylin 1933.—Plants subfilamentous or membranous-expanded, with intercalary growth and ultimately parenchymatous subdivision of the cells; unilocular sporangia and plurilocular gametangia present, also gametes upon the microscopic monoecious gametophyte. Family subdivision within this order is not yet absolutely definite owing to the fact that exact cytological studies have not been made upon an indicative scale, and Tilden (1935) and Taylor (1937) divide the order differently into at least three families.

Tilden: Scytosiphonaceae.

Asperococcaceae.

Coilodesmaceae.

Punctariaceae.

Taylor: Stilophoraceae.
 Asperococcaceae.
 Striariaceae.

We have followed Tilden, but admit the tentative nature of the divisions.

SCYTOSIPHONACEAE Foslie 1892.

Scytosiphon C. Agardh emend. Thuret 1850.

S. Lomentaria (Lyngbye) J. G. Agardh. Eastern Bays, Holdfast Bay.

Colpomenia Derbes & Solander 1856.

C. sinuosa (Roth.) Derbes & Solander. Eastern Bays, Encounter Bay, Port Noarlunga, Holdfast Bay.

Hydroclathrus Bory 1825.

H. clathratus (Bory) Howe (= *H. cancellatus* Bory). Encounter Bay, Port Noarlunga, Spencer Gulf.

ASPEROCOCCACEAE Foslie 1890.

Asperococcus Lamouroux 1813.

A. bullosus Lamouroux. Investigator Strait.

PUNCTARIACEAE Kjellman 1880.

Punctaria Greville 1830.

P. latifolia Greville. Eastern Bays.

- (ii.) DICTYOSIPHONALES Setchell and Gardner 1925.—Plants slender and branching with growth from an apical cell, ultimately with parenchymatous subdivision and growth; reproduction from zoospores in small, surface sporangia to give a microscopic filamentous gametophyte which is isogamous. There is one family containing some four genera and about 15 species.

DICTYOSIPHONACEAE De Toni 1891.—Not known to be represented here.

- (iii.) LAMINARIALES Kylin 1917.—Plants of massive construction, solid or hollow, simple or branched, cylindrical to flattened, usually with holdfast, stipe and lamina as three distinct regions; externally parenchymatous, but often with a filamentous medulla; growth intercalary, and generally near the base in adult plants; reproduction from unilocular sporangia borne on general or localized portions of the thallus; zoospores give rise to microscopic, branched, filamentous, oogamous gametophytes bearing retained eggs and motile sperms. The order includes about 30 genera and 100 species and comprises the "Kelps".

ALARIACEAE Setchell 1925.

Ecklonia Hornemann 1828.*E. radiata* (Turn.) J. Agardh. Eastern Bays,
Encounter Bay, Port Noarlunga.*E. lanciloba* Sonder. Great Australian Bight.

LESSONIACEAE Setchell 1925.

Macrocystis C. Agardh 1820.*M. pyrifera* (L.) C. Agardh. Eastern Bays,
Encounter Bay.

(c) CYCLOSPOREAE Aresehoug 1847.—Cytological alternation of generations present, the mature plant being the sporophyte.

FUCALES Kylin 1917.—Division into families varies with the authority, *e.g.*, De Toni (4), Kylin and Taylor (1), Setchell and Gardner (2), and Tilden (2).De Toni: Fucaceae, Sargassaceae, Durvilleaceae,
Splachnidiaceae.

Setchell & Gardner, Tilden: Fucaceae, Sargassaceae.

Kylin, Taylor: Fucaceae.

We have followed Setchell & Gardner (1925) and Tilden (1935) and have retained two families.

FUCACEAE (Lamouroux 1813) Setchell & Gardner 1925.

Adenocystis Hooker and Harvey 1847.*A. lessonii* Hooker and Harvey. Eastern Bays,
Encounter Bay.*Splachnidium* Greville.*S. rugosum* (L.) Greville. Encounter Bay.*Notheia* Baily and Harvey 1855.*N. anomala* Baily and Harvey, usually parasitic on
Hormosira.*Hormosira* Endlicher 1836.*H. Banksii* (Turner) Decaisne. Encounter Bay,
Gulf St. Vincent, Investigator Strait.

This species may be divided into a number of forms, but an ecological study of it is required.

Myriodesma Decaisne 1841.*M. integrifolium* Harvey. Holdfast Bay (von Mueller), but not since collected.*M. serrulata* (Lamour.) Deene. Encounter Bay.*M. tuberosum* J. Agardh. Encounter Bay.

This species is apparently very rare and Agardh records that the specimen collected in 1897 by Jessie L. Hussey at Port Elliot had only been recorded once previously.

SARGASSACEAE (De Toni) Setchell and Gardner 1925.

Cystophyllum J. G. Agardh 1848.

C. muricatum (Turn.) J. Agardh. Encounter Bay.

Carpoglossum Kützinger.

C. confluens (Sond.) J. Agardh. Eastern Bays,
Encounter Bay, Investigator Strait.

Phyllospora C. Agardh.

P. comosa (Labill.) C. Agardh. Encounter Bay.

Scaberia Greville.

S. Agardhii Greville. Encounter Bay, Port Noarlunga, Holdfast Bay.

Seirococcus Greville.

S. axillaris Greville. Eastern Bays, Encounter Bay, Investigator Strait, Holdfast Bay.

Scytothalia (Turn.) Greville.

S. dorycarpa (Turn.) Greville. Eastern Bays, Encounter Bay, Investigator Strait.

Cystophora J. Agardh, Syn. *Blossevillea* Decaisne (orthog. mut.).

C. uvifera (C. Ag.) J. Agardh. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.

C. cephalornithos (Labill.) J. Agardh. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.

C. platylobium (Mert.) J. Agardh. Eastern Bays, Encounter Bay.

C. pectinata (Grev. & Ag.) J. Agardh. Great Australian Bight (Clare Bay).

C. racemosa Harvey. Eastern Bays, Encounter Bay, Port Noarlunga, Investigator Strait.

C. retorta (Mert.) J. Agardh. Encounter Bay, Port Noarlunga.

C. retroflexa (Lab. 1806) J. Agardh 1848. Encounter Bay.

C. botryocystis Sonder. Eastern Bays, Encounter Bay, Gulf St. Vincent, Investigator Strait.

C. Grevillei (C. Ag.) J. Agardh. Encounter Bay, Investigator Strait.

C. spartioides (Turn.) J. Agardh. Eastern Bays, Encounter Bay, Port Noarlunga, Holdfast Bay, Investigator Strait.

C. Brownii (Turn.) J. Agardh. Encounter Bay, Port Noarlunga.

- C. monilifera* J. Agardh. Eastern Bays, Encounter Bay, Port Noarlunga, Investigator Strait.
- C. subfarcinata* (Mert.) J. Agardh. Encounter Bay, Port Noarlunga, Investigator Strait.
- C. polycystidea* Areschoug. Encounter Bay, Port Noarlunga, Investigator Strait.
- C. paniculata* (Turn.) J. Agardh. Encounter Bay, Investigator Strait.
- Sargassum* C. Agardh 1820.
- S. halitrichum* (Aresch.) J. Agardh. Holdfast Bay, Investigator Strait.
- S. Sonderi* J. Agardh. Eastern Bays, Encounter Bay, Port Noarlunga, Investigator Strait.
- S. varians* Sonder. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.
- S. decipiens* (R. Br.) J. Agardh. Eastern Bays, Encounter Bay, Investigator Strait.
- S. verruculosum* (Mert.) J. Agardh. Eastern Bays, Encounter Bay, Investigator Strait.
- S. bracteolosum* J. Agardh. Encounter Bay, Port Noarlunga, Investigator Strait.
- S. lacerifolium* (Mert.) C. Agardh. Port Noarlunga, Holdfast Bay, Investigator Strait.
- S. biforme* Sonder. Le Fevre Peninsula.
- S. cristatum* J. Agardh. Eastern Bays, Encounter Bay, Holdfast Bay, Investigator Strait.
- S. Merrifieldii* J. Agardh. Investigator Strait.
- S. spinuligerum* Sonder. Encounter Bay, Investigator Strait, Denial Bay.

In addition to the above there are a number of species of *Sargassum* which have been collected but must await expert identification, especially in the sub-genus *Arthrophycus*.

III.—Class RHODOPHYCEAE (“Red Algae”).

In the classification of the Rhodophyceae set out below, the list of families and the order in which they are given is from “Anatomie der Rhodophyceen” by H. Kylin (1937). Most of the order and family descriptions were taken from “Marine Algae of the N.W. Coast of North America” by W. R. Taylor (1937), and descriptions of families not given by Taylor are from Kylin’s work. “The Algae and Their Life Relationships” by J. E. Tilden (1935) was used in some cases.

This classification is not necessarily complete in regard to families, for much work is still required on the Red Algae, particularly on Southern Hemisphere forms. All the families given by Kylin are described, although no representatives of several have been found around the southern coasts of Australia. Future work, however, may bring to light new species, particularly if fresh-water forms are searched for. Nearly all the genera listed under the old classification have been placed in the new one, though some not mentioned in the books consulted are listed as “probably”, and we have been unable to place a few others. The order of the genera given under the families in this classification follows their order in the main text.

In the accompanying outline of the classification, only two of the commoner genera of each of the larger families have been mentioned. The other genera will be found in the full classification which follows:—

		Order.	Family.	Genus.
CLASS RHODOPHYCEAE.	PROTOFLORIDEAE.	Bangiales	Bangiaceae.....	<i>Bangia</i> , <i>Porphyra</i>
	SUB-CLASS EUFLORIDEAE	Nemalionales ...	Chantransiaceae ..	—
			Batrachospermaceae	<i>Batrachospermum</i>
			Lemaneaceae	—
			Helminthocladiaceae	<i>Nemalion</i> , etc.
			Thoreaceae	—
			Chaetangiaceae	<i>Galaxaura</i>
			Naccariaceae	—
			Bonnemaisoniaceae .	<i>Bonnemaisonia</i> , <i>Asparagopsis</i> , etc.
		Gelidiales	Gelidiaceae	<i>Gelidium</i>
		Cryptonemiales ..	Dumontiaceae	<i>Dasyphloea</i>
			Gloiosiphoniaceae ..	—
			Endocladiaceae	—
			Rhizophyllidaceae ..	<i>Chondrococcus</i>
			Squamariaceae.....	<i>Peyssonnelia</i>
			Cruoriaceae	—
			Corallinaceae	<i>Corallina</i> , <i>Melobesia</i> , etc.
			Grateloupiaceae	<i>Grateloupia</i> , <i>Cryptonemia</i> , etc.
			Kallymeniaceae	<i>Kallymenia</i> , <i>Callophyllis</i> , etc.
			Choreocolaceae	—

Order.		Family.	Genus.
CLASS RHODOPHYCEAE.	SUB-CLASS EUPHORIDEAE.		
		{ Calosiphoniaceae . . .	—
		{ Nemastomaceae	<i>Nemastoma</i> , <i>Schizymenia</i>
		{ Sebdeniaceae	<i>Sebdenia</i>
		{ Furcellariaceae	—
		{ Solieriaceae	<i>Solieria</i>
		{ Rissoellaceae	—
		{ Rhabdoniaceae	<i>Rhabdonia</i> , <i>Erythroclonium</i> , etc.
		{ Rhodophyllidaceae . . .	<i>Rhodophyllis</i>
		{ Hypneaceae	<i>Hypnea</i>
		{ Plocamiaceae	<i>Plocamium</i>
		{ Sphaerococcaceae . . .	<i>Stenocladia</i> , <i>Phacelocarpus</i>
		{ Stictosporaceae	<i>Stictosporum</i>
		{ Sarcodiaceae	—
		{ Gracilariaceae	<i>Gracilaria</i> , <i>Melanthalia</i> , etc.
		{ Mychodeaceae	<i>Mychodea</i>
		{ Acrotylaceae	<i>Acrotylus</i> , <i>Hennedya</i>
		{ Phyllophoraceae	<i>Stenogramme</i>
		{ Gigartinaceae	<i>Gigartina</i> , <i>Iridophycus</i>
		{ Rhodymeniaceae . . .	<i>Rhodymenia</i> , <i>Chrysymenia</i> , etc.
		{ Champiaceae	<i>Champia</i> , <i>Chylocladia</i>
		{ Ceramiaceae	<i>Callithamnion</i> , <i>Ceramium</i> , etc.
		{ Delesseriaceae	<i>Delesseria</i> , <i>Nitophyllum</i> , etc.
		{ Dasyaceae	<i>Dasya</i> , <i>Thuretia</i> , etc.
		{ Rhodomelaceae	<i>Polysiphonia</i> , <i>Laurencia</i> , etc.

Class RHODOPHYCEAE Oltmanns 1904.

Plants unicellular, filamentous or parenchymatous; cells usually uninucleate, with from one to many rose-red chromatophores; cell division mitotic; growth apical or intercalary; life cycle in the higher forms showing a regular alternation of generations, the gametophytes producing gametes (eggs and sperms) and the sporophyte producing spores.

The broad classification is set out in the accompanying table.

Subclass PROTOFLORIDEAE Rosenvinge 1909.

Morphological alternation of generations not present, the plants being either entirely asexual or consisting of monoecious or dioecious gametophytes, the zygote representing the sporophyte; protoplasmic continuity between the cells not evident. No true trichogyne.

Order BANGIALES Schmitz and Hauptfleisch 1896.

Plants may be unicellular, may form flat membranes of one or two cell layers, or they may be erect, forming unbranched or branched filaments; cells uninucleate, spherical, oval, or somewhat angular from pressure, usually similar in form throughout the plant body, with intercalary growth; chromatophores single, axial, stellate, with a large central pyrenoid, usually containing more or less phycoeyanin in addition to the other pigments; nuclei somewhat simple in structure; reproduction in unicellular forms by simple fusion; in multicellular forms by means of motionless, haploid,

naked gonidia, which are developed directly from a vegetative cell or by the division of a vegetative cell; development in the higher forms by the fusion of sperms and eggs; sperms very minute, eggs large; zygote, following meiosis, dividing directly into four to eight spores; germinating spores producing monoecious or dioecious gametophytes.

Family BANGIACEAE (Zanardini) Berthold 1882.

Gonidia arising by division or developing directly from an originally vegetative mother cell (gonidangium); in special monogonidangia, cut off by a curved wall in a vegetative cell.

Porphyra C. Agardh. *Bangia* Lyngbye. *Wildmania* De Toni.

Subclass EUFLORIDEAE De-Toni 1897.

Morphological alternation of similar generations shown or inferred to be present, the plants being either male and female gametophytes or sporophytes; in most of the higher forms at least, the sporophytic generation having its origin in the zygote, which in conjunction with one or more auxiliary cells remains as a parasite on the female gametophyte, diploid carpogonia being produced within a cystocarp; carpogonia, upon germination, building up the sporophytic plant, which in turn bears quartets of haploid spores (tetraspores); protoplasmic continuity between cells as a rule.

Order NEMALIONALES Olinanns 1904.

Plants filamentous, the uniseriate filaments creeping or erect, or stouter and corticate, when developing relatively soft branches with either the central filament or the multiaxial type of structure; cells uninucleate, with axial or lateral chromatophores and with intercellular connections; asexual reproduction by monosporangia, very exceptionally by bi- or tetrasporangia; sexual reproduction by spermatia in spermatangia formed from the surface vegetative cells and carpogonia with elongated trichogynes borne on few-celled carpogenic branches; the zygote itself producing the carpospores after meiosis either directly or after establishing connections with nutritive cells on the carpogenic branch.

This order includes marine algae, purely fresh-water forms, and certain species able to endure either salt or fresh water.

Family CHANTRANSIACEAE Kylin 1928.

Plants small, filamentous, with apical growth and a more or less evident erect or prostrate axis; cell arrangement uniseriate, the cells uninucleate, with one or more chromatophores; asexual reproduction by mono-, bi-, or tetrasporangia, formed laterally or terminally; sexual reproduction by small-branched spermatangial filaments producing spermatia and by carpogenic branches of one to three cells, the cystocarps small, with carpospores formed in sparingly branched filaments.

Family BATRACHOSPERMACEAE Kylin 1928.

Primary filament composed of a row of large cells, growing by means of a hemispherical apical cell. Whorls of densely branched lateral ramuli are produced at the nodes, giving a characteristic beaded appearance. From the basal cells of the lateral branches, cortical threads grow downward on the outside of the large axial cells, ultimately forming a complete cortex. After fertilization, short, branched, filaments of cells develop from the base of the carpogonia, the end cells forming carpospores. The gonimoblasts lie embedded in mucilage between the assimilatory filaments, and a mass of protective filaments may be developed.

Members of this family are mainly fresh water inhabitants. An unidentified species of *Batrachospermum* occurs in ditches at Mount Compass, South Australia.

Family LEMANEACEAE.

The species of *Lemanea* grow mainly in cool, clear mountain waters, and are usually yellow-brown, green-brown, or black in colour. They are often found in fissures, the thallus often consisting of a more or less upright system of branching filaments. In the development of a filament, a central cell is formed surrounded by at first four and later a number of cells, and eventually a central filament is present, separated by a space from a cortex one or two layers thick.

The carpogonial branch is formed from cells within the cortex, and is usually three celled, but the basal cell may branch and develop into another carpogonial branch. After fertilization the carpogonium develops inwardly a cell filament, which forms a much branched tuft of filaments, most cells forming carpospores. The carpospores are freed by breaking of the old filament or through an opening in the internode, but they may be preserved in the mother plant for a time.

Family HELMINTHOCLADIACEAE Kylin 1928.

Plants of moderate size, erect and coarsely branched, very mucoid, sometimes partly calcified; structurally with an axial row of cells, or multi-axial with many filaments in the centre developing lateral assimilative branches of the "fountain" type; monosporangia present or absent; sexual reproduction by spermatangia borne in loose clusters on the ends of the assimilatory filaments; carpogenic branches borne variously on the assimilators, usually of three cells, the terminal being the carpogonium and auxiliary cells being absent; cystocarp immersed among the assimilative filaments, without a definite pericarp, the gonimoblasts closely branched and the outer cells producing the carpospores.

Nemalion Targioni-Tozzetti. *Helminthocladia* J. Agardh. *Helminthora* J. Agardh. *Liagora* Lamouroux.

Family THOREACEAE.

The thallus is of the "fountain" type, and a colourless central region and coloured outer region can be distinguished. The outer region is usually composed of unbranched assimilatory filaments, radiating in bunches from the central body. The central body is composed of filaments, mainly longitudinal at the periphery but more transverse in the centre. The masses of filaments, and the whole plant, are covered with mucous, only the long assimilatory filaments passing out through the mucous. The systematic position of the genus *Thorea* is much disputed. The species of *Thorea* are found in quickly running streams or rivers, but none have as yet been recorded from Australia.

Family CHAETANGIACEAE Schmitz 1889.

Plants of moderate size, erect and bushy of habit, soft in texture, sometimes partly calcified; structurally multiaxial, the filaments in the centre developing lateral branches of the "fountain" type, the outer cells of which may be closely associated into a continuous epidermis; monosporangia absent from most genera, but sometimes present; spermatangia scattered over the surface of the plant as little cells in small groups; carpogenic branches three-celled, borne on inner forks of the lateral filaments, the cell below the carpogonium capable of originating nutritive cells; cystocarps immersed, the gonimoblasts developed from the carpogonium; pericarp of slender crowded filaments produced from the lower cell of the carpogenic branch, eventually forming a pore at the surface.

Galaxaura Lamouroux.

Family NACCARIACEAE.

The plants belong to the central filament type. They form, in their existence in the sea, a series to some extent parallel to the fresh-water forms *Batrachospermum* and *Lemanea*. The thallus development is similar to *Batrachospermum*. A whorl of four pericentral cells is formed, which form groups of short, branched filaments, from the basal cell of which long thin rhizoids grow out and surround the strongly developed central axis. From the rhizoids develop assimilatory filaments, but in old plants of *Naccaria* these are broken down and the cortex becomes the assimilatory organ.

The carpogonia develop from the basal cell of the fertile short filaments, and are two or three celled. After fertilization the supporting cell and carpogonium unite, the gonimoblast filaments developing from the carpogonium. Outer filaments form a layer around the central filaments, and the end cells of crowded, upright, branched filaments in the centre form carpospores.

Family BONNEMAISONIACEAE Engler and Prantl 1897.

Plants of moderate size, slenderly branched, with an evident axis and extensive branch systems; growth apical, an axial row of cells being surrounded by short, compact, branched cell rows constituting a pseudo-parenchymatous cortex with a continuous surface; sporangia unknown; spermatangia in dense masses covering small lateral branchlets; carpogenic branches lateral on the corticating cell rows, forming after fertilization a cystocarp with a definite pericarp, which is chiefly developed from adjacent tissue and which surrounds the gonimoblasts and associated nutritive cells.

Bonnemaisonia C. Agardh. *Asparagopsis* Montagne.

Probably *Leptophyllis* J. Agardh. *Ptilonia* J. Agardh. *Delisea* Lamouroux.

Order GELIDIALES Kylin 1925.

Plants with slender, wiry, redidivided branches; corticated, ultimately developing the multiaxial type of structure; assimilatory cells with lateral chromatophores; asexual reproduction by tetraspores formed after meiosis in sporangia at or below the thallus surface; sexual reproduction by spermatia in spermatangia formed from the surface cells and carpogonia on carpogenic branches loosely associated with chains of nutritive cells; the carpogonium producing gonimoblast filaments, on which carposporangia are borne among the nutritive cells; auxiliary cell lacking.

Family GELIDIACEAE Kylin 1925.

This is the only family in this order, and contains the genera *Gelidium* Lamouroux, and *Pterocladia* J. Agardh.

Order CRYPTONEMIALES Oltmanns 1904.

Plants showing various shapes from filiform to fleshy-membranous or rocklike; corticated, with the multiaxial type or the central filament type of structure with an apical cell; asexual reproduction by tetraspores formed after meiosis in sporangia at the thallus surface, or in sunken pits or conceptacles; sexual reproduction by spermatangia borne on surface cells or the lining of conceptacles and by carpogonia on carpogenic branches sunken in the cortex or in conceptacles; the carpogenic branches being associated with typical auxiliary axes which are neighbouring to the carpogenic axes or more commonly remote; carpogonium after fertilization ordinarily producing oöblast filaments which transmit the diploid nuclei to the auxiliary cells, from which the carposporangium-bearing gonimoblast filaments are produced.

Family DUMONTIACEAE (Bory) Schmitz 1889.

Plants more or less branched, or plane and entire, soft; the original axial filament and apical growth soon obscured, the plants then appearing to have a pseudo-parenchymatous cortex and a filamentous, often hollow

medulla; sporangia tetrapartite; spermatangia superficial on the male plants, widely distributed; carpogenic branches scattered, of five cells, the carpogonium fusing with an intermediate cell in the branch from which oöblastic filaments go out to auxiliary cells in separate axes, which in turn give rise to the scattered cystocarps.

Dasyploea Montagne.

Family GLOIOSIPHONACEAE.

Plants soft and bushy; structurally composed of a central filament with compact lateral assimilatory filaments; sporangia tetrapartite; carpogenic branches of three cells, carried on a supporting cell common to the associated auxiliary axis of seven or eight cells, the fifth being the functional auxiliary; cystocarps attached to the bases of the assimilatory filaments, without a pericarp.

Family ENDOCLADIACEAE.

Thallus of the central filament type; apical cell two-faced, forming two pericentral cells, and either tufts of small branches or a number of thin filaments develop, resulting finally in a pseudo-parenchymatous cortex.

Fertile branch tufts developing from the inner cortical cells, and auxiliary cells and two-celled carpogonia formed; after fertilization gonimoblast filaments develop from the auxiliary cell, passing outwards; these are so abundant between the inner cells of the thallus that fusion may occur with these cells, thereby facilitating nutrition. From the gonimoblast filaments develop tufts of small rounded cells, each of which forms a carpospore, the thallus becoming somewhat swollen where the gonimoblasts develop, but with no special protective filaments formed.

Family RHIZOPHYLLIDACEAE.

Plants erect, bushy, dichotomously branching and tough; structurally with a medulla of many longitudinal filaments and an assimilative cortex of branches turning outwards, in some genera these structures derived from an apical cell; tetrapartite sporangia between the cortical cells of the sporangial plants, scattered or in some genera in nemathecium; sexual organs in nemathecium, the carposporic type much swollen; spermatangia lateral on short, crowded, superficial filaments; carpogenic branches associated with quite similar auxiliary axes in nemathecium, the carpogonium fusing with an intermediate cell in the carpogenic branch, from which oöblast filaments go out to auxiliary cells in separate axes, which give rise to the crowded cystocarps.

Chondrococcus Kützinger.

Family SQUAMARIACEAE.

Plants spreading, crustaceous; structurally usually with a basal layer of radiating branched filaments from which an upper layer of compact erect filaments arises, the whole sometimes a little encrusted with lime;

growth peripheral from the ends of the filaments of the basal layer; sporangia tetrapartite, scattered between the erect filaments in nemathecial groups or in crater-like conceptacles; spermatangia in tufts on the ends of the erect, paraphysal filaments; carpogenic branches scattered or in nemathecia, short, lateral on paraphysal filaments; after fertilization the carpogonium fuses with an intermediate cell in the carpogenic branch, from which oöblast filaments go out to auxiliaries formed laterally at the bases of other paraphyses; gonimoblast masses small, scattered, formed from the fertilized auxiliary cells.

Peyssonnelia Decaisne.

Family CRUORIACEAE Kylin 1928.

Plants forming expanded crusts with marginal growth, adhering by the under surface, above forming erect, crowded filaments lightly united; zonate or irregularly tetrapartite sporangia known; carpogenic branches short, the oöblast filaments developing directly from the simple or divided carpogonium to make vegetative unions with various assimilatory filaments, and ultimately to give rise directly to the gonimoblasts, of which all cells are converted to carposporangia; true auxiliary cells absent.

Family CORALLINACEAE (Gray) Harvey 1853.

Plants with a thin basal layer which may develop into a massive calcareous crust or a system of rigid branches, or from which may arise solitary or scattered, erect, slender-branched, jointed axes, the segments showing the multiaxial type of structure with chromatophores in the peripheral cells, and the whole calcified except the intervening flexible joints; reproductive organs in conceptacles with a definite perithecium-like wall, sunken in the crust, or terminal on lateral enlarged branches; tetrasporangia zonate, often associated with sterile paraphysal filaments; spermatangia on short filaments crowded in conceptacles; carpogenic branches usually three-celled, in the central part of the cystocarpic conceptacle, the lower cell acting as the auxiliary; after fertilization union of the carpogonium with the lower cell of the carpogenic branch occurs and then by oöblast filaments with the auxiliary cells at the bottom of other branches, after which general fusions occur, so that the carposporangia ultimately arise from the large fusion cell.

This family includes practically all the calcareous Rhodophyceae.

Lithothamnion Philippi. *Melobesia* Lamouroux. *Mastophora* Decaisne. *Lithophyllum* Philippi. *Goniolithon* Foslie. *Amphiroa* Lamouroux. *Cheilosporum* Areschoug. *Jania* Lamouroux. *Corallina* (Tournefort) Lamouroux. *Archeolithothamnion* Rothpl.

Family GRATELOUPIACEAE.

Plants of this family belong to the "fountain" type. Each segmented cell near the growing point of the central filament forms outwardly a branching system of short filaments, which close over and form the cortex.

The dense outer cortex consists of three or four layers of isodiametric cells, but the inner cortex is fairly loose. Characteristic stellate cells (bearing long processes) occur in the medulla.

The thallus is more or less net like, often flat and leaf like. In forms with a thin thallus, the cortex consists of two or three layers (e.g., *Cryptonemia*); the stouter forms have a many layered cortex, with a large celled inner and small celled outer region (e.g., *Prionites*, *Pachymenia*).

The fertile tuft of branches in the *Grateloupiaceae* is situated in the inner cortex, and always contains a carpogonium or an auxiliary cell. The compound filaments develop directly from the fertilized carpogonia and pass to the auxiliary cells. The first gonimoblast cell after growing outwards forms more thick, crowded, branched, gonimoblast filaments, then most of the cells form carpospores. The tufts of gonimoblast filaments are usually triangular, and the gonimoblasts contain groups of carpospores in various phases of development. The ripe gonimoblasts lie in the cortex and are enveloped by special protecting filaments. A definite osteole is formed.

Halymenia J. Agardh. *Grateloupia* C. Agardh. *Pachymenia* J. Agardh. *Prionitis* J. Agardh. *Cryptonemia* J. Agardh. *Thamnoclonium* Kützinger.

And probably *Epiphloca* J. Agardh. *Polyopes* J. Agardh. *Codiophyllum* Gray. *Blastophyc* J. Agardh.

Family KALLYMENIACEAE.

Plants foliaceous or branched, erect and rather soft; structurally developed at first from an apical cell, but the subsequent growth not producing an axial cell row; when mature with a filamentous or subparenchymatous medulla and narrow, small-celled, assimilative cortex; sporangia scattered or in the branch tips, irregular to tetrapartite; procarps consisting of a supporting auxiliary cell which bears a three-celled carpogenic branch and a sterile cell, or a number of carpogenic branches; gonimoblasts formed from the auxiliary cells or basal cells of the carpogenic branches which then have wide connections with the auxiliaries; cystocarps invested and penetrated by a nutritive tissue of filaments developed from the cells near the procarp.

Kallymenia J. Agardh. *Callophyllis* Kützinger.

Family CHOREOCOLACEAE.

Plants minute, partly or when colourless completely parasitic; consisting of a penetrating basal portion and an emergent part, usually cushion-shaped or with short stout branches; reproductive organs in the emergent part; tetrasporangia tetrapartite; spermatangia produced in series from the surface, or on the lining of conceptacles; carpogenic branches of three or four cells, the supporting cell acting as an auxiliary or cutting one off after fertilization; cystocarps showing a pericarp and an ostiole.

This family is not altogether satisfactorily defined, but serves as a convenient grouping of some rather inadequately studied genera.

Order **GIGARTINALES** Oltmanns 1904.

Plants showing various forms from filiform to fleshy-membranous or crustose; corticated, with either the multiaxial or central filament types of structure; asexual reproduction by tetraspores formed after meiosis in sporangia scattered over the plant just below the surface, or in restricted areas on branches; sexual reproduction by spermatangia borne on surface cells in more or less restricted areas and by carpogenic branches sunken in the cortex; typical auxiliary cells when present more or less remote from the carpogonia, established before fertilization, consisting of enlarged intercalary cells of the cortex filaments; carpogonium after fertilization producing oöblast filaments which transmit the zygote nuclei to the auxiliaries, from which the carpospore-bearing gonimoblasts are produced.

Family **CALOSIPHONIACEAE**.

The plants belong to the central filament type, the central filament being particularly strong, and supporting whorls of abundantly branched short filaments similar to *Batrachospermum*. The carpogonia are three celled and arise from the lower cells of the assimilatory short filaments. The supporting cell unites with the fertilized carpogonium and forms the compound filaments. The auxiliary cell unites with one of the basal cells of the assimilatory short-filament system, and then divides more or less outwards to form a first gonimoblast cell. These usually form opposite the region where the compound filaments fuse with the auxiliary cell. From the first gonimoblast cell develop more densely crowded gonimoblast filaments, then all cells produce carpospores. The gonimoblasts lie among the short filaments; protecting filaments are not formed.

Family **NEMASTOMACEAE**.

Foliaceous or branching plants, rather soft with longitudinally filamentous medulla and compact radially filamentous cortex; sporangia tetrapartite or lacking; spermatangia developed on the outermost cells of the cortex; carpogenic branches of three to seven cells developed on the cortical filaments; auxiliary cells scattered, intercalary, developed in inner segments of corticating filaments, oöblast filaments from the carpogonidia penetrating through the interfilamentous spaces to reach the auxiliary cells; cystocarps developed outwardly from the auxiliaries, the gonimoblasts completely maturing into carposporangia and without special pericarp structures surrounding them.

Nemastoma J. Ag.

Family **SEBDENIACEAE**.

The thallus is of the "fountain" type. The cortex consists of thickly packed filaments giving a parenchymatous appearance, while the medullary tissue shows a looser filamentous structure. The *Sebdeniaceae* represent a

higher developmental stage than the *Nemastomaceae*. From the first gonimoblast cell further thick, branched, gonimoblast filaments develop, and most of the cells form carpospores. The fusion cell formed between the compound filaments and the auxiliary cell becomes richly protoplasmic and forms a nutritive tissue for the gonimoblasts. The cortex over the gonimoblasts is concentrated and somewhat swollen and forms the outer wall of the cystocarp. The gonimoblasts project from the nutritive tissue in the bottom of the cystocarp up into the central hollow space.

Sebdenia Berthold.

Family FURCELLARIACEAE.

Both this family and the *Solieriaceae* have the "fountain" type of structure, and in several respects form a natural evolutionary group. The initial cells of the central filament form a branched system of short filaments, which form the cortex. Rhizoids develop from the old cells of the cortex, and a transverse section of the leaf-like network of the old thallus shows a two or three layered cortex of closely packed cells and a medullary tissue of long filaments.

The carpogonia and auxiliary cells are separated from each other, so that no procarp is formed. The first gonimoblast cell develops inwardly, forms a compound filament, and then more thick, branched, gonimoblast filaments. Generally all cells of the filaments form carpospores. The gonimoblasts lie between the inner cortex and the medulla. The cystocarps have no definite pore.

Family SOLIERIACEAE Kylin 1932.

Plant bushy or plane, subsimple or branched, developing with an axis of several filamentous initials, the medulla continuing clearly filamentous, the cortex obscurely so, appearing subparenchymatous with large cells within; tetrasporangia scattered at the surface, zonate; carpogenic branches of three or four cells borne on the inner cortex; auxiliaries more or less evident, scattered; cystocarp showing a central fusion mass or sterile tissue, often a filamentous sheath with strands between the sheath and the central tissue, discharging by a pore.

Solieria J. Ag.

Family RISSOELLACEAE Kylin 1932.

Thallus flat, leaf like, irregularly forked or lobed; procarp consisting of several carpogonial branches of from two to three cells, which arise from a basal cell, and one auxiliary cell with rich contents. A large irregular fusion cell develops in the centre of the gonimoblast, from the lobes of which proceed the branches bearing carpogonidia arranged in rows; cystocarp wall with a definite pore, the cystocarps being distributed over the

thallus of the female gametophyte, more prominent on one side. Sporangia scattered over the surface of the sporophytic thallus in the outer layer, zonately divided.

The family includes only one species, *Rissoella verruculosa*, not recorded from South Australia.

Family RHABDONIACEAE.

The thallus belongs to the central filament type. Of the four genera in this family, *Catanella* and *Erythroclonium* have a two-edged, and *Rhabdonia* and *Areschougia* a three-edged apical cell. From the apical cells branched short-filament systems are formed, which develop into the cortex. Rhizoids are present in the interior of the thallus of all *Rhabdoniaceae*, in small amount in the forms with inflated thalli, but to a very large extent in forms with solid thalli.

The *Solieriaceae* and *Rhabdoniaceae* possess two common characteristics; firstly, the carpogonium and auxiliary cell are separated from one another, and therefore no procarp is formed, and, secondly, the first gonimoblast cell develops inwardly. However, the *Solieriaceae* thallus is of the "fountain" type while the *Rhabdoniaceae* thallus is of the central filament type.

The carpogonia develop from the central or inner cells of the cortical tissue, and are usually two to three celled, but may be branched. After fertilization the carpogonium develops one or two compound filaments. The auxiliary cell unites with a normal thallus cell in the interior of the cortical tissue, and after fusion with a compound filament a first gonimoblast cell separates on the inner side, and this forms a crowd of filaments, which derive nourishment through the fusion cell. The cortex contains a fairly narrow osteole. The carpospores sometimes germinate in the cystocarp.

Erythroclonium Sonder. *Rhabdonia* Harvey. *Areschougia* Harvey.

Family RHODOPHYLLIDACEAE Kylin 1932.

Plant plane or bushy, subsimple or branched; growth originating from a distinct apical cell, producing an evanescent primary axial cell row covered by an obscurely filamentous cortex; when mature the medulla either diffusely filamentous or apparently parenchymatous, the cortex of larger cells within, smaller without; procarps present, the carpogenic branches of three cells, each with an auxiliary borne on the same supporting cell, the auxiliary equivalent to a segment of a corticating cell series; cystocarp developed from the lobed enlarged auxiliary; pericarp formed by active division of the cortex about the developing cystocarp.

Rhodophyllis Kützinger. *Acanthococcus* H. and H. *Cystoclonium* Kützinger.

Family HYPNEACEAE Kylin 1932.

Plants bushy, laterally branched, branches cylindrical, often with spinulose branchlets and crozier tips; structurally showing a central filament developed from an apical cell, and a filamentous cortex which matures into

a psuedo-parenchymatous structure with large cells within, small cells without; sporangia more or less localized in somewhat swollen branchlets, formed at the surface, zonate; procarps present, the carpogenic branches of three cells on a supporting cell that forms additional corticating series, an inner cell of which forms an auxiliary near the carpogonium; cystocarps swollen, showing a group of filamentous cells anchoring the central mass to the pericarp, the carpospores formed terminally on close branched gonimoblasts.

Hypnea Kützinger.

Family PLOCAMIACEAE.

Fronds compressed, membranaceous, pinnately decompose, the pinnules alternately secund in twos, threes, fours, or fives, composed of a central siphon, an inner layer of longitudinal oblong cells, bounded by a cortical layer of small assimilative cells.

The supporting cell serves the carpogonium as auxiliary cell, and the gonimoblasts develop outwardly from the thallus. The carpogonium is three celled. After fertilization, the carpogonium and supporting cell unite, the supporting cell serving as an auxiliary cell. The first gonimoblast cell develops outwardly from the thallus and forms more thickly crowded tufts of branches, most cells forming carpospores. The cells surrounding the procarp develop into a cystocarp wall, with no special opening.

The tetraspores are zonate and borne in special branches (stichidia).

Plocamium Lamouroux.

Family SPHAEROCOCCACEAE (Dumont) Schmitz.

The early development of the thallus is similar to the *Plocamiaceae*, and a system of short filaments forms around the thallus. The central filament is formed of a crowd of rhizoids. The cortex is well developed and differentiated into a large-celled inner region and a small-celled outer region. In *Stenocladia* the rhizoidal formation is considerably greater than in *Sphaerococcus*, and therefore in *Stenocladia* a strong medullary tissue is formed.

As in the *Plocamiaceae*, the supporting cell serves the carpogonium as auxiliary cell, and the gonimoblasts develop outwardly from the thallus. After fertilization the supporting cell and carpogonium unite and gonimoblast filaments are formed. In *Sphaerococcus* only the end cells of the gonimoblasts form carpospores, but in *Stenocladia* the end cells divide into four, each forming a carpospore, while in *Phacelocarpus* the three or four outer cells of the layer of gonimoblast tissue produce carpospores. In *Sphaerococcus* the cystocarp wall is completely closed, but has a distinct opening in *Phacelocarpus* and *Stenocladia*. In both of the latter genera the cystocarps are produced on special ramuli.

Phacelocarpus Endl. and Dietrich. *Stenocladia* J. Agardh. *Nizymeria* Sonder.

Families STICTOSPORACEAE and SARCODIACEAE.

The development of the gonimoblasts relates these families in some degree with the *Plocamiaceae* and *Sphaerococcaceae*. The formation of the procarp is not known. The gonimoblasts develop outwardly from the thallus, and their nutrition is derived only through the auxiliary cell. In *Trematocarpus* (*Sarcodiaceae*) a large abnormally branched fusion cell is formed. In both families the upper cells of the gonimoblast filaments usually form carpospores. The cystocarp wall is particularly thick and has a distinct aperture.

Family STICTOSPORACEAE.

Stictosporum Harvey.

Family GRACILARIACEAE Kylin 1930.

Plants mostly branched, to even bushy, the branches slender to coarse, cylindrical to strap shaped, firm and often cartilaginous; axes developing from three-sided apical cells, ultimately forming a parenchymatous medulla and a narrow small-celled assimilative cortex which may bear delicate colourless hairs; sporangia tetrapartite, scattered at the surface; spermatangia scattered, cut off from surface cells; carpogenic branches of two cells, the carpogonium fusing after fertilization with the other unit of the carpogenic branch, the supporting cell and the sterile cell series which it bears, and then with several neighbouring vegetative cells which have become richly stored. the large fusion cell thus formed giving rise to the gonimoblasts; cystocarp with a sterile central placenta and a thick projecting pericarp opening by a pore.

Melanthalia Montagne. *Curdia* Harvey. *Gracilaria* Greville. *Tylotus* J. Agardh.

Families MYCHODEACEAE and ACROTYLACEAE.

These families, with the above considered groups of the Gigartinales, are not closely related, but are obviously related in the development of the procarp to the *Phyllophoraceae* and *Gigartinaceae*, and appear to have a similar lowly evolution. However, in all forms of the *Gigartinales* the position of the auxiliary cell in the doubtful families is intercalated with a segmented cell in the thallus. This cell also serves as a supporting cell to the carpogonium. In the *Mychodeaceae* and *Acrotylaceae* each supporting cell forms more carpogonia which are situated laterally on the supporting cell. They are three celled in *Mychodea* and project straight outward, while in *Acrotylus* they curve in a characteristic manner. They are also three celled in *Acrotylus*, but the first cell forms a one-celled side branch. The second cell of the carpogonium is in *Acrotylus* considerably larger than the rest.

In *Mychodea terminalis* the supporting cell increases in size considerably and becomes richly protoplasmic. After fertilization it unites with the auxiliary cell and forms a large crowd of gonimoblast filaments, and from these filaments grow out spore forming tufts of branches. In *M. ramulosa* a richly nutritive tissue develops, combines with gonimoblast, and then produces a crowd of spore-bearing tufts of branches, most of the cells forming carpospores.

In the *Mychodeaceae* the tetrasporangia are zonate and dispersed in the thallus, while in the *Acrotylaceae* they are zonate but in defined sori.

Studies in the *Mychodeaceae* are, however, still comparatively defective.

Family MYCHODEACEAE.

Mychodea Harvey.

Family ACROTYLACEAE.

Acrotylus J. Agardh. *Hennedya* Harvey.

Family PHYLLOPHORACEAE.

Plants bushy, dichotomously branched, the branches cylindrical to membranous; growth from a marginal or apical meristem producing a pseudo-parenchymatous medulla and a close cellular cortex; sporangia tetrapartite, formed in rows at right angles to the thallus surface, the contiguous rows forming a nemathecial sorus; spermatangia developed on outgrowths from superficial cells; procarps present, the carpogenic branch of three cells carried on a supporting cell which serves as the auxiliary and also, with intermediate cells of the branch, forms sterile cells or series; gonimoblasts first growing inward, becoming interwoven with thin sterile filaments producing irregular masses of carposporangia without a definite sheath; sporangial or gametangial reproduction greatly modified in some species.

Stenogramme Harvey. *Gymnogongrus* Mart.

Family GIGARTINACEAE Kylin 1932.

Plant plane or bushy, subsimple or branched, developing with an axis of several filamentous initials, the medulla ultimately pseudo-parenchymatous, the cortex obscurely filamentous, the small outer cells in rows and containing chromatophores; sporangia in sori in the blade, developed from branching rudiments, tetrapartite; spermatangia formed in sori on the surface; procarps present, the three-celled carpogenic branch carried on a supporting auxiliary which after fertilization forms slender-branching gonimoblast filaments which ramify into the medulla and produce a diffuse cystocarp.

Gigartina Stackhouse. *Iridophycus* S. and G.

Order **RHODYMENIALES** Oltmanns 1904.

Plants showing various shapes from filiform to fleshy-membranous, sometimes hollow; corticated, with a modified multiaxial type of structure; asexual reproduction by tetraspores formed after meiosis in sporangia scattered over the plant just below the surface; sexual reproduction by spermatangia borne on surface cells in more or less restricted areas and by carpogonidia on carpogenic branches sunken in the cortex; typical auxiliary cells present, established before fertilization by segmentation indirectly from the cell supporting the carpogenic branch; gonimoblast filaments developed from the auxiliary to form carpospores enveloped by a pericarp.

Family **RHODYMENIACEAE** Schmitz 1889.

Plants plane or bushy, nearly simple or somewhat freely divided, the divisions flat and subdichotomous or subcylindrical and radially branched, solid or hollow, soft to tough-membranous; developing from an apical meristem, the innermost cells large, forming a parenchymatous medulla, the surface cells small, often in short radial series and containing the chromatophores; sporangia sometimes in sori, tetrapartite, formed between these superficial cells from the ends of shortened radial filaments; carpogenic branch three celled, the supporting cell also cutting off an auxiliary mother cell; gonimoblasts extensively branched, most of the cells forming rather small carpospores, the whole eventually enveloped by a loose pericarp, but no sterile filaments penetrate the carpospore mass.

Hymenocladia J. Agardh. *Rhodymenia* Greville. *Chrysymenia* J. Agardh. *Bindera* Harvey. *Epymenia* Kützinger. *Gloioderma* J. Agardh. *Gloiosaccion* Harvey.

Family **CHAMPIACEAE** Bliding 1928.

Plant usually bushy, sometimes sparingly branched, branches cylindrical or compressed, delicately membranous to quite soft; from an apical meristem developing superficial small assimilatory cells, an inner cortex of large cells and a medullary cavity traversed by longitudinal filaments, the filaments bearing lateral secretory cells; tetrahedral sporangia formed from cortical cells and lying just below the surface; spermatangia borne on groups of surface cells of the small male plants, carpogenic branches three- or four-celled, each borne on an inner cortical cell, the auxiliary secondarily derived from the supporting cell; after fertilization the carpogenic branch, auxiliary cell, and others join into a large fusion cell, from which the gonimoblasts and in turn the large carpospores are formed, the whole covered by a prominent ostiolate pericarp.

Champia Desvaux. *Chylocladia* Greville. *Erythrocolon* J. Agardh.

Order **CERAMIALES** Oltmanns 1904.

Plants generally slenderly filamentous and branched, sometimes coarse, strap shaped, or membranous: naked or corticated, with the central filament type of structure developing from an apical cell; asexual reproduction by tetraspores formed after meiosis in sporangia external or more or less covered by the cortex of ordinary branches, or grouped in special sporiferous branches or stichidia; sexual reproduction by spermatangia borne on the axial filaments, often in masses or covering areas of the flat blade-like plants, or covering special colourless branchlets ("antheridia"); and by carpogonia on carpogenic branches borne on the axial or the pericentral cells; typical auxiliary cells present, formed *after* fertilization from the cell supporting the carpogenic branch; gonimoblast filaments developed from the auxiliary to form a mass of carposporangia, which may be naked, partly enveloped by branchlets, or covered by a pericarp.

This order is the highest of the Red Algae.

Family **CERAMIACEAE** Oltmanns 1904.

Plants usually bushy, rarely sparingly branched; branches in some species uniseriate, in others corticated, usually cylindrical, infrequently flat; growth from the tip producing an axial row of cells, the apical cell dividing transversely or obliquely; unbranched colourless unsegmented hairs often present, also segmented or unsegmented hyaline filiform extensions from the tips of branches, and tufts of hyaline filaments with tri- to polychotomous branching; cortication if present usually developed first about the nodes, consisting of a single ring of cells, remaining thus limited or spreading over the internodes in more or less filamentous fashion, later appearing parenchymatous, or else consisting of an investment of rhizoidal filaments; sporangia normally formed upon sporophytic (diploid) plants, superficial or stalked on the branches, single or whorled at the nodes, or in corticated species emergent from or immersed in the cortex, ultimately dividing meiotically in tetrapartite or tetrahedral fashion; spermatangia developed on special determinate branchlets, forming small colourless clusters, or covering the cortex of portions of larger species; procarps developed on the axial cells of branchlets or on lateral or pericentral cells as supporting cells which sometimes also develop into determinate branchlets; carpogenic branch of four cells, borne on the supporting cell, which may also give rise to a few sterile cells and which cuts off one or two auxiliaries near the carpogonium; cystocarp composed of groups of gonimoblast filaments, depending on the presence of one or two fertile auxiliaries, with the outer cells of the short gonimoblast filament producing the carpospores; carposporangial mass naked or enveloped in jelly or partly enclosed by subtending filaments from below. The *Ceramiaceae* of the old and new classification appear to be identical, consisting of the same genera in each case.

Lejolisia Bornet. *Griffithsia* Agardh. *Bornetia* Thuret. *Monospora* Solier. *Pleonosporium* Naegeli. *Callithamnion* Lyngbye. *Spongoecolonium* Sonder. *Haloplegma* Montagne. *Euptilota* Kützing. *Rhodocallis* Kützing. *Ptilota* Agardh. *Dasyphila* Sonder. *Muellerena* Schmitz. *Psilothallia* Schmitz. *Ballia* Harvey. *Antithamnion* Naegeli. *Crouania* J. Agardh. *Lasiotalia* Harvey. *Gattya* Harvey. *Ptilocladia* Sonder. *Spyridia* Harvey. *Bracebridgia* J. Agardh. *Haliacantha* J. Agardh. *Ceramium* Wiggers. *Thamnocarpus* Harvey. *Wrangelia* Ag.

Family DELESSERIACEAE.

Plants usually foliaceous, simple, sometimes bushy, alternately or infrequently dichotomously branched, the branches membranous or infrequently subcylindrical; growth from an apical cell producing an axial row that originates connected lateral cell rows of several degrees to produce a membrane and sometimes also a cortex; sporangia tetrahedral, usually in superficial sori; spermatangia in sori; procarp borne on a supporting cell which first segregates a special segment from which sterile cells are formed and then two lateral cells, both giving rise to four-celled carpogenic branches, or one forming such a branch and the other a second group of sterile cells; auxiliaries developed from the support after fertilization; cystocarp with a basal fusion cell and branched gonimoblasts, the inner cells of which are sterile, the outer (or the outermost) carposporangial, the whole invested by a thin, inflated, osteolate pericarp.

Kylin differentiates three types in the *Delesseriaceae*, viz.:—

- (1) Typical *Delesseriaceae*.—*Hypoglossum* Kützing. *Chauvinia* Harvey. *Phytimorpha* J. Agardh. *Apoglossum* J. Agardh. *Hemineura* Harvey. *Caloglossa* (Harvey) J. Agardh. *Claudea* Lamouroux.
- (2) The *Nitophyllum* type.—*Nitophyllum* Greville. *Platyclinia* J. Agardh. *Pachyglossum* J. Agardh. *Martensia* Hering.
- (3) The *Sarcomenia* type.—*Sarcomenia* Sonder.

Probably *Sonderella* Schmitz and *Sonderia* F. v. Mueller also.

Family DASYACEAE.

Plants bushy or with long, cylindrical primary branches, these coarse in simple specimens to more slender in bushy types; primary axes bearing radially or dorsiventrally monosiphonous branched filaments of limited growth which may be free or united into a network; growth not continuous from a persisting apical cell, the successive segments before cortication producing laterally a new growing point displacing the preceding apex, which

develops into a lateral tuft of monosiphonous filaments; axes in some genera corticated by the development of a circle of perieentral cells, the first cell developing to the right of the displaced axis and the subsequent cells in a circle to the left from this, and also by the bases of the lateral filaments which may eventually develop into a heavy investment; lateral filaments in some cases becoming polysiphonous in the lower segments, but monosiphonous above and often ending in colourless filiform extensions, forking occurring by the formation of a new branch laterally from the subterminal cell; sporangia produced in special polysiphonous swollen branchlets or stichidia; colourless spermatangia borne on lateral branchlets; procarps developed near the bases of the lateral tufts of filaments, the fertile perieentral cell producing two sterile initials and the four-celled carpogonic branch, the auxiliary being cut off from the support near the carpogonium; cystocarp enveloped by an ample ostiolate pericarp.

The family *Dasyaceae* corresponds to the tribe *Dasyeae* of the *Rhodomelaceae* in the old classification.

Thuretia Decaisne. *Dasya* C. Agardh. *Heterosiphonia* Montagne. *Haplodasya* Falkenberg. *Halodictyon* Zanard. *Tylocolax* Sehmitz.

Family RHODOMELACEAE Oltmanns 1904.

Plants usually bushy, sometimes sparingly branched; branches usually cylindrical, often delicate, occasionally flat; growth from persisting apical cells producing an axial cell row; branched colourless hairs (trichoblasts) often present, formed in a definite spiral sequence by segmentation from the upper margin of the primary axial segments before the formation of the pericentral cells; axial cells generally surrounded at least in the fruiting portions by a series cut off from them by longitudinal walls (perieentral cells) producing a typically polysiphonous structure, the first developing directly under the initial which forms the trichoblast, subsequent pericentral cells originating to the right and left from this one, and the branches sometimes further corticated either by subsequent divisions of these to several degrees or by appressed rhizoidal down-growths; sporangia formed on sporophytic (diploid) plants from internal segments of the pericentral cells, ultimately dividing in tetrahedral fashion, and the branchlets bearing them usually little modified, but in extreme cases stichidium-like; "antheridia" developed from trichoblast rudiments in the form of colourless tufts, cones, or plates of spermatangia; procarps developed from polysiphonous basal trichoblast segments, the last-formed and fertile pericentral cell as a supporting cell probably producing first the initial of a lateral group of sterile cells, then that of the four-celled carpogonic branch, and finally before fertilization the initial of a basal sterile group; from the supporting cell beside the carpogonium after fertilization an auxiliary is cut off, from which, with a fusion cell organized after fertilization, the gonimoblasts are produced; outer cells of the gonimoblasts alone forming carpospores; cystocarps becoming enclosed by an ostiolate pericarp.

This family corresponds to the *Rhodomelaceae* of the old classification, with the tribe *Dasyeae* raised to the rank of a separate family, the *Dasyaceae*.

Laurencia Lamouroux. *Coryneccladia* J. Agardh. *Janczewskia* Solms-Lauback. *Cladurus* Falkenberg. *Maschalostroma* Schmitz. *Acanthophora* Lamouroux. *Coeloclonium* J. Agardh. *Dolichoscelis* J. Agardh. *Chondria* C. Agardh. *Lophurella* Schmitz. *Falkenbergia* Schmitz. *Polysiphonia* Greville. *Chiracanthia* Falkenberg. *Pollexfenia* Harvey. *Dictymenia* Greville. *Brongniartella* Bory. *Lophothalia* Kützing. *Doxodasya* Schmitz. *Euzoniella* Falkenberg. *Polyzonia* Suhr. *Cliftonaea* Harvey. *Dipterosiphonia* Schmitz and Falkenberg. *Herposiphonia* Naegeli. *Herpopteros* Falkenberg. *Lophosiphonia* Falkenberg. *Protokützingia* Falkenberg. *Amansia* Lamouroux. *Enantiocladia* Falkenberg. *Vidalia* Lamouroux. *Osmundaria* Lamouroux. *Lenormandia* Sonder. *Trigenea* Sonder. *Micropeuce* J. Agardh. *Wilsonaca* Schmitz. *Bostrychia* Montagne.

GLOSSARY.

- Acrogenous*.—Increasing by growth from the extremity.
- Acuminate*.—With a tapering point.
- Adnate*.—Attached over the whole length; growing together.
- Amorphous*.—Having no definite form; of irregular shape.
- Amphora*.—A jar with two handles, tapering at the bottom.
- Anastomosis*.—Union of one vein or filament with another, forming a reticulation.
- Ancipitous*.—Two-edged; two-headed.
- Anisogamous*.—The sexual cells (gametes) showing a difference between male and female.
- Annular*.—Ring-like.
- Antheridia*.—The male sexual organ of the lower plants, in which sperms are produced, incorrectly used in some cases in place of "spermatangia" in the Rhodophyceae.
- Aplanospores*.—Non-motile reproductive cells, formed asexually by true cell formation, and detached for propagation.
- Appressed*.—Lying flat for the whole length of the organ.
- Arachnoid*.—Covered with, or composed of, long loose hairs, resembling a cobweb.
- Arboriform*.—Tree-like.
- Archeozoic*.—The era of earliest life, some 1,000 million years ago.
- Arcuate*.—Bent like a bow; curved.
- Areolated*.—Divided into small spaces or cavities.
- Articulate*.—Jointed.
- Auxiliary (cell)*.—A cell, characteristic of certain orders of the Rhodophyceae, budded off from the pericentral cell either before or after fertilization, and bridging the carpogonium and fusion cell.
- Axile*.—Situated in the axis, or central tissue.
- Bifarious*.—Arranged in two rows; double.
- Bilocular*.—Divided into two cells or compartments.
- Biseriate*.—Arranged in two rows or series.
- Byssoid*.—Composed of fine threads; thread-like.
- Caespitose*.—Growing in tufts; having many stems from one base.
- Calathiform*.—Cup-shaped, almost hemispherical.
- Calcarate*.—Furnished with a spur.
- Calcareous*.—Chalk-like; having the substance of chalk.
- Canaliculate*.—Channelled, with a longitudinal groove.
- Carpogonium*.—The female reproductive cell of the Rhodophyceae which contains the egg.
- Carpосporangia*.—Sporangia in the cystocarp, which bear the carpospores.
- Carpospore*.—A spherical uninucleate spore arising from the swollen tips of branch filaments resulting from the fertilization of the carpogonium.
- Cartilaginous*.—Hard and tough; gristly.
- Caulescent*.—Becoming stalked; having a leafy stem.
- Cauliform*.—Having the shape of a stalk.
- "Central Filament" (type)*.—When the thallus is built up from a central filament, which produces lateral filaments; uniaxial.
- Chromatophore*.—A collective term for the various coloured plastids, including chromo- and chloro-plasts.
- Chromula*.—The colouring matter of plants, other than chlorophyll.
- Cilia*.—(1) Vibratile, whip-like processes of protoplasm by which zoospores and similar bodies move. (2) Hair-like processes, commonly marginal and forming a fringe.
- Ciliate*.—Fringed with hairs or cilia.
- Circinnate*.—Coiled into a ring, or partially so.
- Clavate*.—Club-shaped; thickened towards the apex.
- Coalescent*.—Growing together into one body.
- Collateral*.—Standing side by side.
- Concentric*.—Having a common centre.
- Conceptacle*.—A flask-like cavity containing the reproductive organs of some algae, particularly the *Fucales*.

Concolor.—Uniform in colour.

Confervoid.—Composed of threads; the old name for a group of filamentous Chlorophyceae.

Confluent.—Blended into one.

Connate.—United into one body.

Coriaceous.—Stiff-like leather or parchment.

Corneous.—Having a horny texture.

Corniculate.—Furnished with a small horn or horns.

Coronate.—Crowned; having a corona.

Cortex.—The outer layer (bark or rind) of plant tissues, differing from the internal tissues.

Corticate.—Covered with a cortex.

Corymb.—A flat topped or convex and open flower-cluster.

Corymbose.—Arranged in corymbs.

Costa.—A rib or vein, especially the mid-rib.

Crenate.—Scalloped, crinkled.

Crispate.—Curled.

Cristate.—Crested.

Cruciate.—Cruciform, arranged in the shape of a cross.

Crustose.—Hard, brittle.

Cultrate.—Knife-shaped; sharp edged and pointed.

Cuneiform.—Wedge-shaped; triangular.

Cuticle.—The outermost skin or pellicle of a plant.

Cystocarp.—The characteristic sporophore of the Rhodophyceae, a cyst containing sexually produced spores.

Decurrent.—Extending downwards, as when leaves are prolonged beyond their insertion, and thus run down the stem.

Deltoid.—Shaped like a triangle.

Dendroid.—Tree-like in form or branching.

Dichotomous.—Regularly dividing into pairs.

Diocious.—The male and female elements in different individuals.

Diplobiontic.—The type of life cycle including both the tetrasporic and sexual stages.

Diploid.—The stage when the cells contain twice the basal number of chromosomes, *i.e.*, the sporophyte.

Dissepiment.—A partition in an ovary or pericarp.

Distichous.—Disposed in two vertical rows, two-ranked.

Divaricate.—Extremely divergent.

Dorsiventral.—Having distinct upper and lower surfaces.

Dorsum.—The back or dorsal region; the upper side of an appendage.

Echinate.—Beset with prickles.

Ecorticate.—Wholly without a cortex.

Endochrome.—The colouring matter in cells of plants, particularly algae.

Endogenous.—Arising from deep-seated tissues.

Epiphyllous.—Growing on leaves or leaf-like organs.

Epiphyte.—A plant which grows on another, but not parasitically.

Evanescient.—Soon disappearing; lasting only a short time.

Excurrent.—Extending out beyond the apex, often as a muero.

Falcate.—Sickle-shaped.

Farinose.—Covered with a white mealliness.

Fascicle.—A small bundle; a compact cluster.

Fastigiated.—Parallel, clustered and erect branches.

Favella.—A dense group of spores arranged without order, and covered with a thin gelatinous envelope.

Fibrilliferous.—Composed of fibres.

Filiform.—Thread-shaped.

Flexuous.—Bent alternately in opposite directions, zig-zag.

Foliaceous.—Having the texture or shape of a leaf.

Folicle.—A leaflet, the secondary division of a compound leaf.

Forcipated.—Formed like a pair of forceps.

- “Fountain” (type).*—When the thallus is multiaxial with many filaments in the centre developing lateral assimilative branches.
- Fructiferous.*—Producing or bearing fruit.
- Fructiform.*—Fruit-like.
- Fucoid.*—Resembling the structure of the *Fucales*.
- Funicular.*—Resembling a small cord or thread.
- Funiliform.*—Resembling a cord in toughness and flexibility.
- Furcate.*—Forked, with terminal lobes which are like prongs.
- Fusiform.*—Thick, but tapering towards each end; spindle-shaped.
- Fusion Cell.*—The large compound cell formed after fertilization by the fusion of the carpogonium and auxiliary cell or other cells, and from which the gonimoblasts develop.
- Gametangia.*—The organs in which the gametes of some algae are produced.
- Gametophyte.*—The generation which bears the sexual organs, producing gametes, in turn giving rise to the sporophyte.
- Genesis.*—The act of producing or giving birth to anything; formation.
- Glabrous.*—Smooth, destitute of hairs, or unevenness.
- Glandulose.*—Containing glands; resembling glands.
- Glomerate.*—Collected into heads or dense clusters.
- Gonidangium.*—The organ in the gametophyte which produces a sexual spore or gonidium.
- Gonidia.*—The sexual spores produced in the gonidangium.
- Gonimoblast.*—Filaments, often clustered, arising from the fertilized carpogonium of the Rhodophyceae.
- Haplobiontic.*—The life cycle in which meiosis takes place in the carpogonium and the vegetative sporophyte is lacking.
- Haploid.*—Possessing the typical single set of chromosomes characteristic of the mature gamete.
- Heterocyst.*—A large inert cell in the filaments of certain algae, particularly the Cyanophyceae.
- Heterogenous.*—Not uniform in kind.
- Heterothallic.*—Having unlike sporophytic and gametophytic thalli.
- Hirsute.*—Hairy, with long, fairly distinct, hairs.
- Homology.*—The identity of parts.
- Homothallic.*—Having like sporophytic and gametophytic thalli.
- Hyaline.*—Colourless or translucent.
- Hymenium.*—An aggregation of spore mother-cells in a continuous layer on a sporophore, particularly in certain fungi.
- Imbricated.*—Overlapping, like tiles on a roof.
- Incised.*—Having deep and sharp notches.
- Infracortical.*—Beneath the cortex.
- Inosculate.*—To unite by contact; to anastomose.
- Intercalary.*—Growth taking place between the apex and the base.
- Interstices.*—A space between things closely set.
- Intramatrix.*—Inside a matrix; inside the parent stem.
- Involucre.*—The tissue of the thallus, or bracts, grown up and surrounding the flowering head, embryo, or stem.
- Involute.*—Rolled inwards from the edges.
- Isogamous.*—When the gametes or sexual cells are of equal size.
- Laciniae.*—Lacinated, fringed, cut into deep narrow lobes, or slashed structures.
- Lamella.*—A thin plate or scale.
- Lanceolate.*—Narrow, tapering to each end.
- Lanceoidea.*—Sub-lanceolate.
- Ligneous.*—Woody.
- Ligulate.*—Tongue-shaped; furnished with a ligule.
- Limbate.*—Bordered.
- Lithophyll.*—A fossil leaf, or leaves.
- Lubricous.*—Smooth, slippery.
- Lyrate.*—Lyre-shaped or spatulate and oblong, with small lobes towards the base.

- Matrix*.—(1) The body on which a plant grows. (2) The material in which cells or tissues are embedded.
- Meatus*.—An intercellular passage.
- Medulla*.—The central, usually looser, tissue of the thallus.
- Moniliform*.—Resembling a string of beads.
- Monochromatic*.—Consisting of one colour.
- Monoeceious*.—Having the male and female reproductive organs separate but on the same individual.
- Monopodial*.—Having a single and continuous axis.
- Monosiphonous*.—Consisting of a single central siphon surrounded by jacket cells.
- Monosporangia*.—Undivided tetrasporangia.
- Monostromatic*.—Composed of a single layer of cells.
- Mucronate*.—Possessing a short and straight point.
- Multiaxial*.—Thallus formed from numerous longitudinal filaments.
- Multifid*.—Cleft into many lobes or segments.
- Muricate*.—Rough, with short and hard tubercular excrescences.
- Nemathecium*.—A wart-like elevation of the surface in some Rhodophyceae, containing antheridia and paraphyses or cystocarps.
- Nidulate*.—Partially encased or lying free in a cavity.
- Node*.—That part of a stem which normally bears a leaf or whorl of leaves.
- Nodose*.—Having numerous or conspicuous nodes; knotty or knobly.
- Nucleus*.—The central body of the cell which carries the hereditary factors, or chromosomes.
- Obconical*.—Conical, but attached at the narrower end.
- Obcordate*.—Inversely heart-shaped, the notch being apical.
- Obovate*.—Inversely ovate, with the distal end the broader.
- Ocellated*.—Marked with circular spots of colour.
- Oöblast*.—Filaments produced from the fertilized egg.
- Oogamous*.—When the two gametes are differentiated into egg and sperm.
- Orifice*.—A mouth or aperture; an opening.
- Ostiole*.—The opening of the conceptacle or cystocarp.
- Paniculate*.—When branches or inflorescence are in a loose pyramidal form.
- Paraphysis*.—Sterile filaments occurring in the fructifications of algae and other low groups of plants.
- Parenchyma*.—The soft cellular basal tissue of plants.
- Parietal*.—Borne on, or belonging to the wall.
- Patent*.—Spreading.
- Pectinated*.—Pinnatifid with narrow segments set close like the teeth of a comb.
- Pedicellate*.—Borne on a stalk.
- Pellucid*.—Wholly or partially transparent.
- Peltate*.—Shield-shaped, having the stem attached to the lower surface instead of the base or margin.
- Penicillate*.—Pencil-shaped, with a tuft of hairs.
- Penninerved*.—Pinnately veined.
- Penultimate*.—Last but one.
- Percurrent*.—Extending throughout the entire length.
- Pericarp*.—The wall of a fruit, capsule or ovary.
- Pericentral*.—Around the centre.
- Periderm*.—The outer layer of bark.
- Petiole*.—The stalk between the leaf blade and the stem.
- Phyllodium*.—A petiole or branch developed into the form of a blade.
- Phylogeny*.—Ancestral history deduced from development.
- Piliferous*.—Bearing hairs, or tipped with them; hair pointed.
- Pilose*.—Hairy, usually with soft and distinct hairs.
- Pinna*.—One of the primary divisions of a compound leaf.
- Pinnate*.—With leaflets arranged along each side of a common petiole.
- Pinnule*.—Secondary pinna.
- Placenta*.—The tissue from which the sporangia arise.

Plastid.—A protoplasmic body in active cells, differentiated as centres of metabolic activity.

Plexus.—A network.

Polychotomous.—Dividing regularly into numerous branches at the one point.

Primordia.—An organ in its earliest condition.

Proliferous.—Bearing progeny as offshoots, applied to branches or fronds.

Procarp.—The fertilized carpogonium together with the trichogyne.

Protoplasm.—The viscous living substance in all plants and animals which forms the basis of life.

Protuberant.—Prominent; bulging out.

Pulvinate.—Cushion or pad-shaped.

Pyrenoid.—Minute, rounded, granular, colourless bodies, embedded in the chromatophores.

Pyriform.—Pear-shaped.

Quadrated.—Four-sided; four-cornered.

Quadrifarious.—In four ranks or rows.

Rachis.—The axis of a compound leaf or frond.

Ramification.—The process of branching or separating into branches.

Ramulus.—A branchlet.

Reniform.—Kidney-shaped.

Reticulated.—Net-like.

Rhizoid.—A hair, often branched, serving as a root-like appendage.

Rhomboid.—Quadrangular, with the lateral angles obtuse.

Rimose.—With chinks or cracks, as in old bark.

Rostrate.—With a beak, narrowed into a slender tip or point.

Rugulose.—Somewhat wrinkled.

Sacule.—A little bag-shaped object.

Sagittate.—Shaped like the barbed head of an arrow.

Saxicolous.—Growing on rocks.

Scutate.—Buckler-shaped, round or nearly round.

Secund.—Parts of organs arranged on one side only.

Seriate.—Arranged in a series of rows.

Sessile.—Resting directly on the branch or stem without a stalk.

Seta.—A bristle; a stalk bearing a sporophore.

Setaceous.—Beset with bristles; bristle-like.

Sinus.—A depression between adjoining lobes.

Sorus.—A cluster of fruiting organs on the thallus.

Sperm.—A male reproductive cell.

Spermatangium.—The organ containing the spermatia.

Spermatium.—A male, non-motile, gamete-cell, characteristic of the Rhodophyceae.

Spinose.—Spiny; having spines.

Spongiose.—Soft, with the texture of a sponge.

Sporangium.—The organ in which asexual spores are produced.

Sporophyte.—The plant in the life cycle which produces the asexual spores.

Squarrose.—Rough or scurfy with spreading and outstanding processes.

Stichidium.—A special sac-like branch containing tetraspores.

Stipe.—The stalk or petiole of a frond.

Striae.—Minute grooves or channels.

Stroma.—A cushion-like tissue, often bearing fruiting organs.

Stupose.—Tow-like, with tufts of long hairs.

Subtend.—To extend under, or be opposite to.

Subulate.—Awl-shaped.

Supporting Cell.—The cell below the carpogonial branch.

Surculus.—The basal runner attaching the plant to the substratum and producing upright shoots.

Sympodial.—When lateral branches below the apex become the main growing point, the old apex being laterally displaced.

Terete.—Circular in transverse section, cylindric and usually tapering.

Ternate.—Arranged in threes.

Tessellated.—Formed of little squares, checkered.

Tetrasporangium.—The organ in which tetraspores are formed.

Tetraspore.—A non-sexual spore, one of a group of four, characteristic of the red seaweeds.

Thallus.—The vegetative body, undifferentiated into stem and leaves, of most seaweeds.

Thyrsoid.—A dense panicle.

Tomentose.—Densely pubescent with matted wool, or short hairs.

Torulose.—Cylindric, with swollen portions at intervals, somewhat moniliform.

Trichoblasts.—Bunches of hair-like processes characteristic of certain Rhodophyceae.

Trichogyne.—The elongate receptive cell, attached to the carpogonium, and through which the spermatia enter the carpogonium.

Trichothallic.—When the shoot ends in one or more multicellular hairs or a tuft of such; growth occurring at the base of the hairs.

Trichotomous.—Branching in a three-forked manner.

Tricuspid.—Tipped with three points.

Tubercle.—A small excrecence on a plant.

Tufa.—Soft porous stone, etc., formed by deposition from water, usually calcareous.

Uliginous.—Growing in swamps; slimy, muddy.

Umbilicate.—Having a projection.

Unilateral.—One-sided, either originating or, usually, all turned to one side.

Unilocular.—One-celled.

Uniseriate.—In one row or series.

Urceolate.—Pitcher-like, hollow and contracted at the mouth, swelling below.

Veilate.—Veiled.

Ventral.—The lower side of a creeping plant, in contrast to the upper or dorsal.

Ventricose.—Swollen or inflated on one side.

Verrucose.—Covered with wart-like protuberances.

Verticillate.—Whorled.

Vesicle.—A small bladder or cavity.

Vesiculose.—As if composed of little bladders.

Virgate.—Wand-shaped, twiggy.

Whorled.—The arrangement of organs in a circle round an axis.

Zonate.—Marked into circular zones.

Zoospore.—A motile, asexual, reproductive spore with cilia.

Zygote.—A body produced by fertilization or conjugation of two gametes.

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